LITERATURE.

Review of the Foreign Engineering and Industrial Press.

(Specially translated and prepared for ENGINEERING NEWS.)

Mémoires de la Soc. des Ingénieurs Civils.—One of the questions that has been so long debated in the European press,—how to prevent assassination in railway cars,—has not yet found its solution. A recent number of the *Journal Amusant* had a joke on this subject, which is no joke: "The only railway line in Europe where you are not likely to be assassinated." Above was a little engraving of the Rigi mountain train—consisting of one car, with one compartment. The terrible murder of M. Barrême "provoked" the Government to name a committee chosen half from State, and half from civil engineers to study the best means of preventing such "railway accidents." M. Armengaud said he was much struck with the fact that all the present means of inter-communication require the aid of the person about to be attacked—the man who is asleep, or stunned by a blow, should have pressed an electric button or given some signal! He thought it might be possible by the telephone and microphone to gather all sounds on the train for the conductor's car. Experiments have been made on the Nord line. He thought too that one day the electric properties of selenium might be utilized, so that the conductor might see into the compartments. He believed that no objection could be made with regard to the "indiscretions" (*sic*) that might be seen. It is evident that here M. Armengaud had in his "mind's eye" a *voyage de noces*, with all its concomitant circumstances. A paper was read by M. Cabanellas, "On the application of dynamic electricity to the transport and distribution of energy in its principal forms: heat, light, electricity, chemical and mechanical action." This is, from a scientific point of view, a itter attack on M. Marcel Deprez, who is after all, the man who began the practical adoption of electricityto the transmission of power The paper is very long, and was not finished at the first sitting, but seems to be important from a general and electric point of view. An analysis of M Considère's work on "The Use of Iron and Steel" completes the number.

Moniteur Industriel (Brussels).—It would seem that practical steps are now beirg taken to have a complete survey for the proposed canal through France, from the Atlantic to the Mediterranean. From a military point alone the consequences would be great—Gibraltar would, metaphorically, be no longer on a rock. A large corps of engineers have been appointed to study the question, A couple of societies have already applied for the job, and have their own surveys—the plan of the *Societé de travaux francais* is said to be well "studied." We see that a company has also been formed at Grenoble with the view of joining the Isère with the Lake of Bourget, and later with the Lake of Geneva, and thus cut out the Gothard Tunnel, which is doing French traffic a great deal of injury It also proposes to create a navigable route from Grenoble to Lyons by the valleys of the Morge and the Bourbre. An article on "The Influence of Magnesia on Portland Cements" is taken from the *Comptes Rendus*. A long article on "The Use of compressed air in making long tunnels" by M. Colladon describes the work of that gentleman, for which he obtained the Fourneyron prize. M. Colladon was the first to make use of an injection of atomized water in the interior of the cylindric air compressors, the most powerful means of preventing the overheating of the air during compression, and this was first applied by him during the St. Gothard tunnel works. This, one of the most interesting chapters of modern civil engineering has yet to be written *in extenso*. The article deals first with the Fréjus tunnel works. M. H. Maus was charged by the then Sardinian Government to make surveys for a line from Genoa to Turin, and for a tunnel connecting Piedmont and Savoy. It would seem that the first perforating machines were the invention of M. Maus, but the ventilating system was altogether defective. The idea of Maus was to transmit the exterior hydraulic forces to the tunnel, by the means of two endless cables carried on two pullies, and c rculating through the whole excavated length with the "excessive average speed of twelve metres per second. The ventilation was most defective. All these surveys were begun in 1849-50. It was owing to the support of General Menebrea that the Sardinian Government decided to make a tunnel through Mount Cen s. In comparing the Fréjus, Saint Gothard, and Ariberg tunnels, it is seen that the difficulties that had to be overcome in cutting through the Saint Gothard were of an almost insurmountable nature; the hydraulic power furnished the contractor, the celebrated Louis Favre, was only 50 *per cent.* of that promised; on the north side the enormous pressure of soil in process of decomposition, necessitated masonry work three times the thickness of the plans, and this had to be made over three times! The Ariberg tunnel work went along smoothly, chiefly because the inventions employed in the Saint Gothard were utilized. A description of the Cantero rail is illustrated. The inventor claims that his metallic sleepers will last thirty years, and effect a saving of 600 francs per annum per kilometer.

Eisen Zeitung.—A letter by J. Petsche about the Nijni-Novgorod fair gives some interesting details of the great Russo-Asian trade: The trade of the fair amounts to the colossal figure of 250 million roubles. Russian industry finds a great drawback in the 134 official holidays, to which must be added the "blue Mondays," which the Russian workman is not behind hand in giving himself. The government does a great deal, however, to keep up home factories. It lately took on the great Malzoff Works in Briansk, where 20,000 men were employed. It pays 80,000,000 roubles annually in railway and steamboat subsides. It may surprise our readers to hear that the number of steamers and tows in Russian waters is now over 3,000! Immense railway construction is in progress, or mapped out; these are the railway nets of Siberia, Turkestan, Caucasus, and Trans-Caspian. Then, the canal to join the River Ob with Lake Aaral is in progress—it will ultimately join this latter with the Caspian. In a very few years an Oriental America will grow up, and such names as Batoum, Tiflis, Baku, Astrachan, Orenburg, and Tashkend, will be in the mouths of every business man. In the charming works of Atkinson on Siberia and Central Asia, the whole Middle Asian plateau is designated as the great wheat producing country of the future.

The day is gone by when one of Goethe's characters says: "They may fight as they like down there in Turkey," or words to that effect. A letter from Constantinople tells us of the commercial crisis in that city. We were always of the opinion that the Turks were too lazy to get up a crisis—certainly they would be poor hands at making a panic, but still a "dull times," period would seem to be quite within the possibilities of Turkish life. Want of means of communication—roads and railroads is assigned as one of the principal causes. Smyrna and Salonica are growing up and taking away commerce.

Giornale dei Lavori Pubblici.—Railway building is being carried on to a "vigorous extent"—for Italians,—in Italy. The railway net is now finished in England France and Germany, but Italy and Russia have still a great deal to do. American engineers who have to utilize Italian labor, although they may have to put numbers on certain parts of their clothing, can readily understand that labor is cheap and abundant. An article on the inauguration of the Aosta-Donnaz line is an evidence of the enthusiam of the Italians for the "iron horse." Erckmann-Chatrian in their novel, *Maitre Daniel Rock*" crystallize the hatred and dread of the European peasant to the railway; but this sentiment is a thing of the past.

Revista di Artigliera e Genio.—The last issues have some very interesting articles for the military engineer. The publication is under the direct supervision of the government departments, and is very creditable. Among the more prominent articles are: "Artillery practice in the Servian-Bulgarian war; and" Permanent Fortifications." An article by General Araldi treats of the course of spherical formed shells and the air resistance. Colonel Benedictis gives his ideas on, "New dynamic formulas" as to sappers, in which marching is considered, and the whole question of force "output" brought down to a fine point. "Mining experiments with explosives with nitro-glycerine base" continues the experiments at the Avigliana factory and the article is profusely illustrated in colors.

Le Genie Civil.—There was a very keen competition for the contract for building the bridges at Oporto (Portugal) known to all lovers of "old Port." The French school of bridge building carried the day, and French engineers are very jubilant, although it was a Belgian firm which had the contract. Such houses as Cail & Co., John Dixon, La Compagnie Fives-Lille and Eiffel who is to build the big tower at the Paris Exposition sent in their drawings, M. Seyrig, in the name of the Willebroeck Society was however, successful. Oporto, and its suburb-Villanova de Gaila form the richest and most commercial city in Portugal and their 150,000 inhabitants, separated by the river Douro had no other means of communication than an old suspended bridge that was built fifty years ago—and which "offered very poor security for the confiding passenger. A rigid bridge could hardly be built as the river is very deep, and the bottom of such a nature that no pillars could be built between the two banks. The government decided that the bridge should have two roadways—one fifty metres above the other. The total length of the upper between the abutments is 389[illegible] metres.' Curiously enough just before the bridge was completed two furious storms broke over the city, and tested the cables. The bridge is justly considered as a combination of engineering skill, and artistic beauty. Mr. Vindt writes on the "Calculation of the proportion between the vacuum in a heap of stones and its apparent volume." This knowledge as he observes is very useful in computing the amount of mortar to be used in masonry work and on the quantity of lime in making mortar.

Wochenschrift des Oesterr-Ing. u. Arch. Vereins.—An illustrated article on the "Boston Sewer Works is mainly taken from "Main Drainage Works of the City of Boston," by Elliot C. Clarke. The paper speaks in the highest terms of the system, and the book describing it. Other subjects treated of are: The Pressbury Water Works," and a translation from the Dutch on "Water levels in Holland." Even the French believe that the best engineers in the world for drainage are the Dutch. Voltaire once, however, bid them a sad goodbye, saying: Adieu, ducks, Dutch and dikes."

NEW PUBLICATIONS.

A short treatise on Leveling by Vertical Angles and the method of measuring distances by telescope and rod, with tables of heights. By AUGUST FAUL, Civil Engineer, New York: John Wiley & Sons, 1886.

This is a quarto-volume, bound in limp cloth, which contains 16 pages of text and 45 of tables. The author's method of finding the horizontal distance between two points, is to take the reading on a stadia rod and multiply it by the cosine of the angle of elevation or depression between the points. A short table occupying about a quarter of a page is given for this purpose, as the distances are said to count from the eye end of the telescope. To find the difference of level the horizontal distance is to be multiplied by the tangent of the angle, and to facilitate this operation 45 pages of natural tangents and their multipliers are given. The length of the slope line obtained by reading is said to be affected in a small degree by the perpendicular position of the instrument at the point from which the angle is taken. The stadia recommended is that illustrated in the U. S Coast Survey report for 1865, the better form given in later reports not being mentioned.

The theory of the stadia is so thoroughly understood, and is given in so many standard books, that it is surprising that such erroneous views should be enunciated at this day. The distance read on the rod is well known to count from a point in front of the object glass, and not from the eye end of the telescope. The horizontal distance is well known to be the product of the reading by the square of the cosine of the angle of inclination, plus a small correction to reduce it to the center of the instrument. Thus, if on an inclination of 14 degrees, the reading on the rod is 600 feet, the horizontal distance will be 565 feet counted from the point in front of the object glass, or about 566 feet counted from the center of the instrument; while by the author's method the horizontal distance is given as 582 feet from the eye end of the telescope or about 581½ feet from the center of the transit. The correct difference of level for this case is 141 feet, while the author's method gives 145 feet. Serious errors are therefore likely to result from the use of this "treatise."

Second Annual Report of the Supervisory Board of Commissioners of the New York Municipal Civil Service. 8vo pamphlet, 193 pages.

At the commencement of Mayor Grace's present term of office, it is said he found the Supervisory Board of Commissioners, comfortably domiciled in an up-town house, having asked for $50,000 with which to carry on their examinations, and he removed their quarters to a room in the City Hall, after which the affairs of the Commission were concluded for less than $17,000. As this economy in municipal expenditures is nowhere mentioned in the report, it is a pleasure to refer to it.

The report of the Supervisory Board, consisting of E. P. Wheeler, Chairman; E. L. Godkin, and E. R. Robinson covers reports to the Mayor and to the Legislature, statistics, the various examination papers, their own names and that of the examining board, with the New York City Civil Service Regulations.

The report to the Legislature deals with the appointment of policemen.

That to the Mayor mentions a steady increase in the efficiency of the system and deals with the difficulty resulting from political influence, or "pull," as it is called. Instancing the case of sanitary inspectors, where 22 per cent. of the appointees obtained 90 or more; 30 per cent. between 80 and 90; 48 per cent. between 70 and 80, or; 44 per cent. of those obtaining 90 or more were appointed, 44 per cent. of those obtaining 80 to 90, and 38 per cent. of those obtaining from 70 to 80. The average standing of all certified for appointment was 81.05 and the average standing of those appointed was 81.69. This is thought to show that, the "pull" even if it existed, had on the whole operated in favor of some of the best of the candidates as well as some of those not so well qualified. The Commissioners after referring to their suit to compel the engineers on the new aqueduct to submit to a civil service examination, conclude that all the doubts that have been expressed, as to their methods being adapted to ascertain by practical means who are the most competent persons, "are theoretical and are not justified by the facts."

We give as of general interest the examination papers for assistant engineers.

EXAMINATION OF ASSISTANT ENGINEER.

N. B.—In case candidate does not remember formula or method of solving any problem submitted to him, let him name any work upon the subject where such formula or method may be found.

1. What is Civil Engineering?

2. Have you ever pursued a course of study in any educational institution, or with any civil engineer, which would fit you for the position of assistant engineer? If so, state when and with whom; state also, in detail, what experience you have had?

3. Have you ever had *responsible* charge of any public work? If so, state particulars.

4. Solve the following according to the algebraic signs:

$$\sqrt{\frac{(6\frac{3}{4}-4\frac{1}{2})\times 8\frac{7}{16}}{4\frac{5}{16}}} \times 67873.367, \text{ and show your work.}$$

5. The population of a certain town, in 1880, was 7,095; it having increased 25 per cent. in 10 years, what was it in 1870? Show your work.

6. How many feet, board measure, in the flooring of a room 20′ × 30′ and 2½ inches thick?

7. Find value of x and y in the following equations:

$$2x + 3y = 33.$$
$$4x - y = 17.$$

8. Find value of x in equation $x^3 - x - 40 = 170$?

9. Find value of x in equation $\frac{a}{b} + \sqrt{\frac{a^2 - x^2}{x^2}} = \frac{x}{b}$

10. Explain the meaning of the expression $a^{\frac{1}{2}} \times b^{\frac{3}{4}}$.

11. What is a logarithm?

12. What is the base of the common system?

13. In making what calculations are logarithums useful?

14. How do you find the logarithm of a number in a table of logarithms?

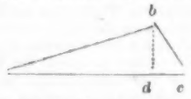
15. What are similar triangles?

16. How are similar triangles proportioned to each other?

17. The sides of a polygon being prolonged, what is the sum of all the exterior angles equal to?

18. How do you pass the circumference of a circle through 3 given points not in the same straight line?

19. How do you describe a square in a circle?



20. In the triangle b being a right angle, what proportion does d b bear to a d and d c?

21. How do you inscribe a regular hexagon in a circle?

22. What proportion do circumference and areas of circles bear to their radii?

23. How do you find the area of a regular polygon? 24. Of an irregular polygon? 25. Of a circle? 26. How do you find the solid contents of a cylinder? 27. Of a wedge? 28. Of a pyramid?

29. Find the contents of the wedge, base 20′ × 30′, height 10′, edge 15′?

30. State the prismoidal formula; would you use it in calculating earthwork?

31. Is a simple question in calculating areas.—Ed. Eng. News.

32. How many and what parts of a plane triangle must be given to find the rest?

33. Define the terms sine, co-sine, tangent and co-tangent?

34. What are natural sines, co-sines, etc.?

35. What is a table of logarithmic sines, co-sines, etc.?

36. Two sides and two angles of a plane triangle being given, how do you find the other parts?

37. When two sides of a plane triangle and their included angles are given, how do you find the other parts?

38. In the right-angled triangle $A\ B\ H$ express algebraically the value of the sine, co-sine, tangent, and co-tangent of angle A in terms of a, b and h, they being the altitude, base and hypothenuse of the triangle?

39. What is the law of gravitation?

40. Do you understand that there is any difference in the meaning of the terms gravitation and gravity?

41. What is the law of falling bodies?

42. Express algebraically this law, taking v = velocity of falling body; g = acceleration of gravity; and h = height?

43. What is the center of gravity of a body?

44. How is it found?

45. Where is the center of gravity of a homogeneous body whose sides are all rectangles?

46. What is the specific gravity of a body?

47. What is the standard for solids and liquids?

48. What for gases?

49. What laws govern the pressure of liquids at rest?

50. How do you find the number of gallons of water to the cubic foot?

51. What is the weight of a gallon of water?

52. What is the pressure per square inch on the side of a vessel at the depth of 10 feet below the surface of the water?

53. What will be the theoretical volume of discharge per second from a reservoir through a pipe 1′ in diameter discharging at a depth of 100′ below the surface of the water?

54. How many gallons of water will be discharged through a pipe 1′ in diameter, 328′ long, head 13½′, co-efficient of flow = .007?

55. State how many men are needed to make up a full party for a survey of a preliminary line or location of a public work, such as a railroad or aqueduct.

56. State also their several duties.

57. For what purpose is the magnetic needle used in surveying land?

58. What is a traverse table and for what used?

59. How do you set out a circular curved line upon the ground?

60. If an obstacle occurs to alignment, state how you would overcome it upon straight lines; also upon curves?

61. The radius of a curve being given and angle of intersection of the two tangents, how do you find the length of the tangent from their intersection to the beginning of the curve?

62. Describe an engineer's transit, and name its adjustments'

63. Describe a Y level, and name its adjustments.

64. How many kinds of leveling rods do you know of?

65. State how they are graduated, and how they can be read to the $\frac{1}{1000}$ of a foot.

66. Show a form of field-book for transit notes used when "running" curves, and place thereon notes of a 5° curve for 1,000, with two intermediate "set-ups."

67. Show a form of level-book, and place therein sufficient figures to show your method.

68. What are cross-sections?

69. How do you set slope stakes for excavation and embankment?

70. What is a grade line?

71. What proportion of the breaking weight of a beam would you consider a safe load?

72. With the load uniformly distributed, what fractional part of the whole weight may be considered, in all calculations, as being carried at the center?

73. Suppose a beam supported at both ends, and take w=weight, l=length of beam, b=breadth, d= depth, s=breaking weight. Express algebraically the value of s in terms of the other quantities.

74. Sectional area being 36 square inches, which would be the stronger section, 6× 6 or 4×9?

75. Make a design for a pair of rafters, connected by a tie beam, for a roof 30 span, showing the dimensions of the several parts and the manner of connecting them. State in detail your method of obtaining the several dimensions.

76. How do you apply the principle of the parallelogram of forces in determining the strain on the various members of a structure? Illustrate graphically.

77. What should be the thickness at the top and base of a retaining wall 15 feet high, built to retain ordinary earth? Show your method of obtaining the required dimensions; also a sketch of the wall, showing how it should be founded.

78. A reservoir is to be built—depth of water 10 feet. If the walls are built of masonry, find the thickness of the same, and state how they should be built. Show your work.

79. What is an arch, of how many forms, and of what may it be constructed?

80. Can you state how you would find the thickness of an arch of stone, span and rise being given?

81. Define the intrados and extrados of an arch.

82. Where should the line of resistance to pressure be found in an arch in order to retain its stability.

83. Can you find the thickness of the abutments, the rise and span of the arch being given?

84. In a semi-circular arch, where is the horizontal thrust greatest and were least?

85. Name the common kinds of stone used in building.

86. Define the terms "quarry-faced," "rough-pointed," "fine-axed," "bush-hammered," as applied to the dressing of stone.

87. Describe "rubble" masonry, "ashlar" masonry, and "broken ashlar" masonry.

88. What are "headers" and "stretchers?"

89. What should be the proportion of "headers" to "stretchers?"

90. How would you prepare the foundation for a heavy wall, and how deep should it be excavated?

91. How are walls founded on soft or yielding materials?

92. Describe a good quality of bricks, and state how you would know a good brick from a poor one?

93. In how many ways is brick-work "bonded" to make good work in heavy walls?

94. What is hydraulic cement, and how many kinds do you know of?

95. Which do you consider the better quality, Rosendale or Portland, and why?

96. What is mortar composed of, and how mixed?

97. What kind of sand should be used, and how do you test its quality?

98. What is the meaning of the term "setting," as applied to cement?

99. How would you test cement?

100. What is concrete; of what composed, and in what proportion should its ingredients be mixed?

101. Name the common kinds of wood used in building?

102. What kind of timber resists decay longest under ground?

103. How may timber be preserved from decay?

104. What do you understand by limit of elasticity as applied to a beam under strain or pressure; what is meant by the neutral axis of a beam?

105. What is the tensile strength of a good quality of wrought-iron per square inch?

106. For what parts of a structure may cast and wrought-iron be used in reference to tension and compression?

107. Make a sketch of the form of cast-iron beam best adapted to resist a transverse strain?

The whole number of persons examined in 1885 were

Competitive	2,246
Non-compititive	163
	2,409
Number passed	2,143

The new civil service regulations provide that there shall be a board of examiners composed of six citizens, designated by the Mayor, and of the secretary of the boards, one secretary serving for the supervisory and examining boards. The examining board is, according to the report, Thomas Byrnes, Inspector of Police: Hugh Bonner, Assistant Chief Fire Department; Horace Loomis, Engineer-in-charge of Sewers; W. L. Hardy, City Physician; Geo. N. Williams, R. T. Greener, and Charles H. Woodman, Chief Examiner and also Secretary. The Mayor may at any time substitute another citizen in the place of any one so designated, and will employ a suitable person as secretary and executive officer. The rates of compensation shall be fixed by the mayor, who will employ assistance, procure suitable offices, etc.

The Supervisory Board shall aid the Mayor; at his request, conduct such inquiries as it may deem expedient; control such examinations, and decide from time to time, subject to revision by the Mayor, all questions arising under these regulations.

These regulations, it will be observed, leave the original civil service board occupying about the same relation to civil service that the Indian held to the turkey after his hunting expedition with the Yankee.

But the arrangement so far has worked satisfactorily

The weight to be given to the results of examinations in the case of persons for whose duty special knowledge is required, not including physicians, etc., embracing engineers, is

1 Technical knowledge	50
2 Experience	20
3 Efficiency and accuracy in work	15
4 Character for maintaining discipline, etc.	15
	100

Regulation 41 provides that "no person in the public service is under any obligation to contribute to any political fund, or to render any political service, and no person shall be removed or otherwise prejudiced for refusing to do so." A working faith in the power of the Supervisory Board to enforce this regulation would save much money to the servants of the city during the coming autumn.

The report ends with a classification of the employés of the city in which it is observable that the first class not subject to examination, includes laborers, secretaries, clerks and others occupying a strictly confidential position.

In the Department of Public Works this class covers clerks, as in Finance Department, Deputy Commissioner, Chief Clerk, Chief and Consulting Engineers, Water Register and Purveyor: Engineer in charge of Sewers, Superintendents of Streets, Street Improvements, Lamps and Gas, Repairs and Supplies and of Incumbrances.

In the Department of Docks, Clerks, as before, Secretary, Engineer in Chief, Clerks to President and Treasurer, Superintendents of Repairs and of Docks.

In the Department of Public Parks the following are comprised in the first class Clerks as above: Secretary, Superintendent, Engineer of Construction, Topographical Engineer, Superintendent 23d, and 24th wards and General Inspector. The others, except laborers, etc., are graded in the second class and are examined.

Neither the Supervisory Board, the Examining Board, nor the Examiners and Secretary, are apparently subject to examinations.

NEW PUBLICATIONS RECEIVED.

Statistics of Power and Machinery Employed in Manufactures. By PROF. W. B. TROWBRIDGE. Part I. *Reports on the Water Power of the United States.* Census Office, Washington, 1885.

Third Annual Report of the Board of R. R. Commissioners of the State of New York for the fiscal year ending September 30, 1885. 2 Vols. 8 Vo. Albany, 1886.

From the Institution of Civil Engineers.

Abstracts of Papers in Foreign Transactions and Periodicals.

Water Purification. By PERCY F. FRANKLAND.

The Granada Earthquake of Dec. 24, 1884. By E. J. T. MANBY.

English and American Railroads Compared. By EDWARD BATES DORSEY. Abstracted.

The Wear of Steel Rails. By GEO. HARRY FOOTNER.

Recent Researches in Friction. By JOHN GOODMAN.

Sewer Ventilation. By GEO. R. STRACHAN.

Explosives of Gaseous Mixtures. By DUGALD CLERK.

Blasting Operations at Hell Gate, N. Y. By L.V. VERNON HARCOURT.

Hydraulics. The Flow of Water through Orifices, over Weirs, and through open Conduits and Pipes. BY HAMILTON SMITH, Jr., C. E. John Wiley & Sons, 15 Astor Place, N. Y. 1886. Price $8.00.

Eighty-Fourth Annual Report of the Chief Engineer of the Philadelphia Water Department, for the year 1885. Philadelphia 1886.

Transactions of the American Society of Civil Engineers for June 1886.

CONTENTS: On specifications for strength of Iron Bridges.

The Magazine of Art for August 1886. CASSELL and COMPANY, 739 Broadway, N. Y. Price $3.50 a year. Single copies 35 cents.

We cannot say too much in praise of this beautifully illustrated, and beautifully printed Magazine. It is full of gems of the engraver's art.

Reports relative to the filters for the Water Supply of the Capital. By THOMAS W. SYMONDS, Captain of Engineers, U. S. A. Senate Document No. 154.

Report on the Condition of the Aqueduct Bridge at Georgetown, D. C. By S. T. ABERT, U. S. Agent, to the Chief of Engineers. Senate Document, No. 138.

Report on River Improvements in Oregon and Washington Territories. By W. A. JONES, Major of Engineers, U. S. A. Senate Document, No. 138.

Reports on Methods of Tunneling Washington Aqueduct. To accompany House Bill 9736.

Irrigation Engineering. By WALTER H. GRAVES, C. E. Paper read before the Denver Society of Engineers in June, 1886.

Railroad Washouts. By CHARLES W. FOLSOM. Reprint from Journal of the Association of Engineering Societies. Read April 7th 1886.

From H. C. Litchfield, Sarasota, Fla. *Report on the Recent Gold Discoveries in the Division of Kuysna.* By THOS. BAIN, ESQ., District Inspector. P. W. D. Description of the Gold Mines, Capetown, South Africa, 1886.

Electric Railways, and the Electric Transmission of Power Described in Plain Terms. By ROBERT LUCE, Boston. W. J. Harris & Co. 1886. Price 50 cents.

Naval Brigade and Operations Ashore. No. 20 Naval Professional Papers. Being a Hand-Book for Field Service prepared from Official and Standard Authorities. By H. K. GILMAN, 1st Lieut. U. S. M. C. From the Bureau of Navigation, Washington, D. C., 1886. Tucks.

Colorado. Some Answers to Questions likely to be asked by the Members of the American Society of Civil Engineers during their Visit to Denver on the Occasion of their Annual Convention July 2, 1886. Presented by the DENVER SOCIETY OF CIVIL ENGINEERS. 140 pages. 8 Vo., handsomely illustrated. Referred to at some length in our report of the Convention published elsewhere this week.

Album of the Riley Railway Construction Company. 39 Broadway, New York. Intended to illustrate the Riley System of Elevated Railways.

Men of Mark. GEO. B. ROBERTS, President Penna. R. R. Company. A handsome lithograph portrait, issued by Messrs. Root & Tinker, 19 Tribune Building, New York City. Sent on application with compliments of Murphy & Co., varnish makers, 227 Broadway, New York.

Report of the Select Committee on Ordnance and War Ships. Government Printing Office, 1886.

The Labor Problem. Plain Questions and Practical Answers. Edited by WILLIAM E. BARNES, with an introduction by RICHARD T. ELY, and special contributions by JAMES A. WATERWORTH and FRED WORDRON. New York. Harper and Bros., 1886.

Poor's Directory of Railway Officials and Railway Directors, 1886. First Annual Number containing lists of the Officers and Directors of all the railways in North America, and of the leading organizations auxiliary to the railway system; lists of officers of South American and British railways, etc. Compiled from official Information. Poor's Railroad Manual.

Pile Driving.*

BY E. H. BECKLER, MEM. OF THE WESTERN SOC. OF ENG.

The notes for this paper have been gathered from the construction records of the St. Louis River bridge, on the Northern Pacific Railroad, at Duluth, Minn, It is not probably that any new facts have been discovered on the above mentioned work, but there are many little details connected with pile foundations and pile bridges of considerable length that are interesting and useful to an engineer who may be engaged upon work of this character. In order that such information may be useful, it is necessary that there shall be made known the governing conditions and circumstances, which must be considered in their relations to the results of the work.

The St. Louis river, having its source in several small lakes near the northern boundary of Minnesota, after wandering about through the woods and swamps, trying all points of the compass in vain attempts to get somewhere, approaches within a few miles of the Mississippi river, and as if afraid of the prospect of traveling to the Gulf of Mexico, makes an abrupt turn eastward, and goes tumbling down over granite and sandstone ridges, till it reaches nearly the level of Lake Superior. Here it begins to loiter and spread out, covering a wide tract of country, receiving a variety of names—Spirit Lake, St. Louis Bay, Duluth Harbor, and lastly, Superior Bay. The St. Louis bridge crosses the St. Louis Bay from West Superior to Rice's Point, one of the divisions of Duluth.

This bridge has a total length of 5,607 feet, composed of pile-trestle and truss spans, as follows, beginning at the south end: Pile-trestle, 117 bents, 15-foot spans, 1,756 feet; draw-span, 302 feet; pile-trestle, 151 bents, 15-foot spans, 2,277 feet; combination fixed span, 165 feet; draw-spans 247 feet; pile-trestle, 56 bents, 860 feet.

The foundations for the masonry piers are grillages of pine timber placed upon piles.

The country through which the St. Louis river flows, a succession of pine woods and tamarack swamps, conveys an idea of the material to be found at the bottom of St. Louis bay, through which the piles were driven. Starting at the south end (the bridge lies in a north and south line), there are 400 feet of approach on shore. The soil is red clay, a depth of about seven feet with an underlying stratum of sand. From the shore the bottom slopes off quite slowly for 1,000 feet, until the depth of low water is 8 feet, the clay stratum diminishing in thickness, and disappearing, 600 feet from shore. After the depth of 8 feet of water is reached, the bottom is nearly level, a distance of 3,000 feet, to the river channel. The underlying stratum, probably sand, is not so nearly level as the surface of the mud, if one can judge by differences of penetration of the piles. These differences would indicate that there were several ridges and hollows filled with the river sediment, decomposed vegetation mixed with clay and sand. In some places the sediment has a depth of 38 feet to 40 feet, and everywhere is very soft on top. The river channel is 350 feet wide, cut from the soft mud, giving a depth of 17 feet of water. North of the channel the mud has disappeared, and the material is sand the remaining distances to the north end of the bridge. There is very little current to the water except in the channel, and sometimes a wind from the lake drives the water up the bay.

The profile was made showing the depth reached by each bent of piles and each foundation, which gave the information concerning the depth of mud at various points. The accompanying reduced profile, showing every seventh bent, shows the same although not quite so plainly. This only illustrates that in driving piles, as in many other branches of engineering, the engineer does not fully know how to proceed with the work until it is finished.

The profile of the underlying bed of St. Louis Bay was a very important thing to know before ordering the 2,300 piles necessary for the structure. An approximate profile was obtained by driving test piles at intervals of about 300 feet along the center line of the bridge. When any great difference in the driving was noticed, an intermediate pile was driven. These piles were driven from a scow, and the 300-foot spaces were measured by tying a rope to each last pile driven. The correct position of each pile was afterward ascertained by triangulation.

The records of test piles were kept as follows:

STATION.	No. of pile.	Length.	Diam. top.	Diam. butt.	Depth water.	Dist. driven.	E. top pile.	El. pt. pile.	No. blows.	Fall hammer	Wt hammer
80 + 23.7	16	52′	8½″	15½″	9.7′	39.3′	84.8′	32.8′	120	20′	2,256 lbs.

PENETRATION FOR EACH 10 CONSECUTIVE BLOWS.

13″	14″	16″	17″	15″	12″	12″
50 60	70	80	90	100	110	120

The fall given is for the last 10, 20 or 30 blows. The apparent increase of penetration in the example given between the 60th and 100th was owing to the length of the pile, which permitted only a short drop of the hammer. The notes relating to the dimensions of the piles and the driving were taken at the time by the inspector; the other notes referring to the elevation were obtained afterwards by the engineer. It was intended to drive each test pile until it fulfilled the requirement of the specifications, viz., "Penetration not to exceed one inch under the last blow of 2,000 pounds hammer with drop of 20 feet or equivalent."

By means of the test pile records, with the profile made from them, a list of piles for the structure was made. The list gave piles varying in length from 24 to 67 feet, and the piles were put in as at first arranged, with very few alterations. It is not possible that the length of piles required could have been determined so satisfactorily by sounding or boring, and the additional information derived from the test piles, as to the number of blows, and thereby the time, was more than worth the expense.

The driving of the piles for the bridge proper began the 11th of December, 1884, after the ice was formed in the bay. By the specifications only white pine, tamarack, or oak could be used; but owing to the difficulty of obtaining such long straight trees, Norway pine was allowed for lengths over 45 feet. No oak was furnished, and but few tamaracks. It was

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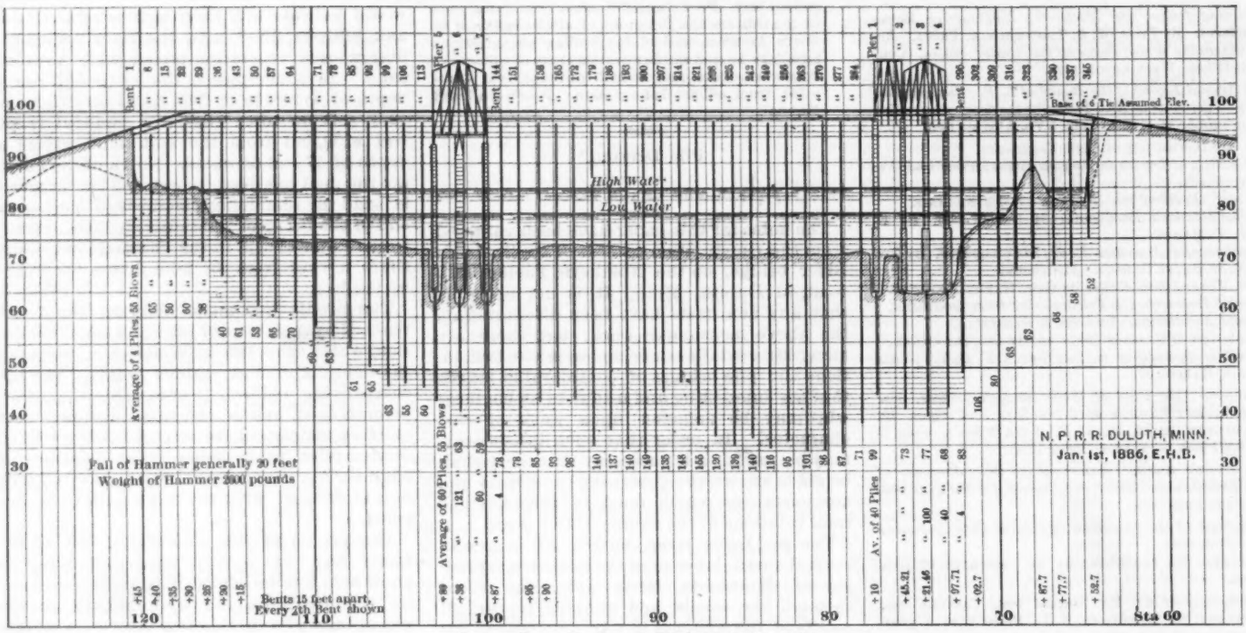
PROFILE OF ST. LOUIS RIVER BRIDGE.


High Water
Low Water
Base of 6 Tie Assumed Elev.
Fall of Hammer generally 20 feet
Weight of Hammer 2000 pounds
Bents 15 feet apart,
Every 2d Bent shown
N. P. R. R. DULUTH, MINN.
Jan. 1st, 1886, E.H.B.
Sta 60

Scales; Vertical, 1" = 30'; Horizontal, 1" = 900'.

soon found that the Norway pine was the preferred wood, on account of not splitting. A great many days the thermometer was lower than minus 15 degrees, and it was seldom that a white pine could be driven without shattering it in such severe weather. Most white pine piles over 50 feet long that were tried had to be cut down and replaced.

At first, to prevent splitting, the head of the pile was protected by an iron follower weighing 900 pounds, which also served to hold the pile in place, the follower being made to run in the leaders like the hammer. The advantages in the use of the follower were more imaginary than real, and there was one serious objection. For holding the pile in position, yoke, staples and bars were more certain, and the apparently good condition of the pile head after driving was quite deceptive. When sawed off it was invariably seen that the blows had shaken the timber until the layers or rings were separated, and they could be removed in pieces one-half to three inches thick, leaving only a small circular core. The objection to its use was that it greatly reduced the effect of the blow. A piece of hard wood, generally elm, was placed in the top of the follower to receive the blow, and after being struck a few hundred times the fibers became separated, and the block received the blow very much like a piece of india-rubber. Also the force of each blow expended in driving the additional weight of 900 pounds, on top of the pile, was not inconsiderable. An equal number of blows upon a pile banded with a wrought iron ring $\frac{1}{2}$ inch × $2\frac{1}{2}$ inches would show an increase of total penetration amounting to two or three feet, in each case the pile being driven until the last ten blows drove it 10 inches. This difference occurred when piles were being driven 15 to 20 feet. In other words, the loss in effectiveness, due to the follower, as determined by quite a number of piles, was from one-fifth to one-sixth.

On account of the danger from piles being pulled by the ice, the experiment of driving a stick in its natural position, butt down, was tried. Two piles, driven 14 feet apart, gave results as shown in sample of records following. It was proposed at first to drive quite a number of piles in that way, but there were several good reasons for discontinuing the practice. One objection was, with piles of such great length the small amount of heart wood in the stick above water, where the top was only required to be 10 inches diameter, would lead to the decay of the piling in a very few years. The small area of the pile head receiving the blow of the hammer rendered it quite impossible to drive the piles a sufficient distance, without seriously shattering and damaging the stick. The pile drove so slowly that the number of blows required to drive it until it "brought up" would have increased the cost of driving fully twenty-five per cent. It is reasonable to suppose that the ice would not pull a pile driven butt down so easily as the other way, provided they were driven to the same depth. It was impossible to drive to the same depth here.

The records of driving that are usually kept are of very little use. Usually the piles are driven by contract, and often it is left to the foreman to "chock the hammer" when he thinks he has pounded the pile long enough. The penetration under a given number of blows and the total distance driven are hardly thought of, much less recorded, and to a person wishing to make a calculation upon the sustaining power, or desiring to renew the bridge, there is only matter for speculation. The possibility of this structure being injured by ice, and the probability of some renewals and changes, perhaps, for pier foundations, made it quite necessary that complete records of the driving should be kept. If no other good resulted from it, the inspector, with his time fully occupied counting blows, measuring penetrations, noting time and lengths and diameters, could feel that he was something besides a "presence."

The accompanying form of notes was kept throughout the work; the columns giving elevations were supplied by the engineer while marking the height of "cut off" for the "piles cut off," made it necessary that those lengths be recorded. Since it required no additional force in the engineering corps, and served to fully employ those necessary to the work, there is much to commend such a system and nothing to say against it.

Pile drivers were built expressly for the work, with leaders 65 feet long. The engine for raising the hammer was placed upon the driver platform and so gave it stability and reduced the labor of moving.

It was the custom to note the time when the first and last blows were struck upon each pile. With a fall of 20 feet the average was seven blows per minute. It was found quite desirable to know the time lost at all breakdowns, etc., and the cause for the delay.

Those employed by contract do not generally attach sufficient importance to the fact that a short fall, 10 to 15 feet, with a heavy hammer, 2,600 pounds, will drive a pile further without injury than the long drop and light hammer. More blows are required, but not much additional time with the hammer raised by an engine.

For determining the sustaining power a sufficient variety of formulæ are to be found in "Bearing piles." Rudolph Hering, M. A. S. C. E.*

The following tables, made up from the records, will give an idea of the amount of a day's work in number of piles and lineal feet; the ratio of piles cut off to piles in structure; the number of blows required to drive, and various other points of information.

It may not be out of place to mention something of the action of the ice upon a pile bridge in such a locality. The test piles were driven in October, while the bridge was not begun until the ice had attained a thickness of 2 feet, and was rapidly increasing, with the temperature of the air seldom above zero for two months. It was observed during the cold weather that a contraction was taking place in the ice, causing cracks to appear, of various widths up to 8 inches, aggregating about 2 feet. There was also a falling of the water, probably due to the westerly wind, which is common with the cold weather about Lake Superior in winter. The test piles were somewhat inclined, and moved up stream with the shifting ice.

A rising temperature, with an easterly wind, from off the lake, driving back the water, lifted the ice and closed the cracks and threw up a ridge 2 or 3 feet high, nearly parallel to the bridge line. Another cold snap coming on, the same action, as above described, was repeated. It was found that nearly all test piles were broken off (some feet below the

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ground surface, where the material was soft at the top), and the broken portions were raised by the ice. Two, and perhaps three piles, which were 38 to 40 feet in mud, were raised whole. The pointed ends of two were finally brought above the ice, by other means, after the ice had raised them 10 or 12 feet in about six weeks. The water surface sometimes changed, in elevation, 0.5 foot in an hour.

Some bents of piles capped, but not braced, were swayed badly out of line, and inclined longitudinally. In times of considerable ice action, centers on the completed structure showed a lateral deviation of 0.15 foot.

After the ice surface had received a covering of snow, there was less action. The ice attained a thickness of 4 feet in many places along the bridge. There appears to be little or no danger from pulling, but the combined strength of four piles in each bent may be severely tried in resisting the lateral pressure.

The most trying, (the early) portion of another winter has now passed (Jan. 1), and no harm has been done to the structure.

NOTE.—Length of cut-off in pile bridging was considerably increased by the cold weather. With temperature from zero to —30°, piles began to split before being fully driven.

In foundations deduct 20' from cut-off to bring head of pile above water.

In draw protections "average cut-off" shows omission of 18 piles, which were cut off under water.

Mississippi Levees.

The Mississippi Levee Commissioners met at Greenville, Miss., on July 12th and 13th, all members being present. Chief Engineer Wm. Starling was re-elected for the ensuing year. Treasurer S. W. Ferguson reported total expenditures for the year ending June 30th, as $128,-015.30; cash in hand $11,620.39. The Executive Committee reported that the approximate amount of 800,000 yards of embankment would have to be provided for in the estimates for the ensuing year, and a total of $246,200 provided from usual assessment. Before adjournment the Board ordered the advertisement of work (see ENGINEERING NEWS advertising pages) and moved to meet on September 6th to open proposals and let the work. From Chief Engineer Starling's report we make the following extracts:

"There has been a good deal of discussion among levee engineers as to the utility of muck ditches, it being held by some that ordinarily they are a mere waste of money, and that they should be employed, if at all, only in timbered land, or where otherwise specially indicated by the circumstances of the case. All the levees constructed in the upper district for the last two years have been built without muck ditches, except in timbered land, and I have not heard of their giving any trouble. If muck ditches are properly constructed, of sufficient size, and thoroughly tamped with buckshot earth, I believe that they are important aids in cutting off seepage. As ordinarily dug and refilled by contractors, I think their usefulness doubtful. From abundance of precaution and from a reluctance to depart from established usage, I have always employed them heretofore."

"The experience of the past year has confirmed me in the opinion previously expressed that a repair force is not an economical way of doing work, but that when properly managed it is very thorough, and that it is an invaluable auxiliary in time of high water. I think it advisable, then, to maintain the organization, and to direct it principally to such work as cannot well be done by contract—such as digging out and refilling crayfish holes, putting up plank revetments, clearing the levee of trees and brush, putting in benches, etc. To this end, it is my idea that the force should begin at the upper end of the district and work southward over the entire line, repairing every weak or defective place that can be identified, and removing all timber and undergrowth.

"It is my duty to direct your attention to the practice of using the levees as roadways, which is again becoming flagrant. The enforcement of the laws against this abuse does not seem to belong properly to my department, and I merely report to you the fact that such a custom exists and is inflicting material injury to the levees, that the Board may take such action as to them may seem fit. Serious damage is also being done by hogs, which in some parts of the district are allowed to run at large in great numbers on our embankments and tear up the slopes. This practice is especially prevalent at the very time when the levees are most endangered by it; that is, in winter and early spring, just before high water.

"The total expenses of the Engineer's Department, for the two years from July 1, 1884, to July 1, 1886, as they appear upon the books of the Treasurer, amount to $14,341.66. Deduct $1942.38 which are not properly chargeable to engineering expenses, and it leaves about $6,200 per annum as the cost of engineering.

"To some persons even this may seem too great. In fact, the question is frequently asked: Is it not possible to lessen this outlay?

"Movements in the interest of economy are usually prompted by a laudable motive, though they are not always judicious. Such questions are worthy of attentive consideration, and merit a respectful answer. I reply then that in my opinion this expenditure cannot be materially reduced without detriment to the best interests of the district. Of course, the expense may be arbitrarily cut down to any given amount. The board might order that its annual outlay for all engineering purposes should not exceed $5,000 or $4,000 or $1,000; and no doubt they would get some kind of work. But certainly it would not be well done. The experience of the last high water, corroborating that of every other, teaches us that what we have to dread most in our levees, in the time of trial, is faulty construction. Give us levees properly and honestly built, of standard slopes and height, and the whole district may rest behind them in confident security. Nine-tenths of our trouble arise from defects that might have been avoided by proper supervision. A single log in a levee may cause more loss to the district than the salaries of all its officers for ten years. The cost of a few slope stakes fraudulently drawn in would pay an assistant for twelve months.

Work cannot be hastily and yet well done. Under a system which reduces engineering expenses to a minimum, the engineer hardly sees his work from the time he stakes it out, that is before its beginning, to the time he receives it after its completion. He does not know whether the specifications have been

PILE-DRIVING RECORDS.

Date and station.	No. of bent.	No. of pile.	Kind of timber.	Length of pile.	Diam. butt.	Diam. top.	Length below cut-off.	Length cut-off.	Elevation of ground.	Elevation of point of pile.	Distance driven.	Fall.	No. of blows.	Penetrations for a given number of consecutive blows.				
Dec. 27.														10"	10"	5"	4"	1"
*114 + 30	42	1	Wh. P.	40.0'	17"	14"	31.4'	8.6'	76.2'	66.4'	9.8'	20'	85	20 40	60	70	80	85
														10"	7"	7"	7"	.....
†114 + 30	42	4	Wh. P.	40.0'	16"	11"	33.0'	7.0'	76.2'	64.8'	11.3'	20'	60	20 30	40	50	60	.....
																11"	11"	9"
‡Jan. 10. 112 + 65	53	3	Wh. P.	42.0'	15"	13"	36.0'	6.0'	74.8'	61.8'	13.0'	18'	50	.....	20	30	40	50
																13"	10"	8"
§	....	4	.....	41.0'	17"	11"	37.3'	3.7'	74.8'	60.4'	14.3'	18'	50	.....	20	30	40	50
														48"	38"	30"	24"	.....
Feb. 4.	183	1	Nor. P.	67.0'	18"	11"	65.6'	1.4'	73.9'	32.2'	41.7'	20'	138	100 110	120	130	138	.....
														36"	40"	33"	28"	20"
	....	2	Nor. P.	67.0'	18"	10"	66.0'	1.0'	.....	31.8'	42.2'	20'	148	.. 110	120	130	140	148
														40"	38"	36"	35"	35"
93 + 15	....	3	Nor. P.	67.0'	20"	13"	64.9'	2.1'	.....	32.8'	41.1'	20'	150	.. 110	120	130	140	150
														40"	35"	30"	30"	.....
	....	4	Nor. P.	67.0'	20"	12"	65.3	1.7'	.....	32.4'	41.5'	20'	140	.. 110	120	130	140	.....
															22"	17"	15"	10"
Jan. 20.	135	1	Nor. P.	60.0'	17"	11"	57.7'	2.3'	72.6'	40.1'	32.5'	18'	65	.. 25	35	45	55	65
															16"	15"	13"	8"
100 + 35	....	2	Nor. P.	62.0'	19"	13"	59.5'	2.5'	.....	38.3'	34.3'	18'	65	.....	35	45	53	65
															19"	15"	10"	.....
	....	3	Nor. P.	60.0'	19"	13"	57.3'	2.7'	.....	40.4'	32.2'	18'	55	.....	35	45	55	.....
															14"	13"	12"	10"
	....	4	Nor. P.	60.0'	18"	13"	57.1'	2.9'	.....	40.7'	31.9'	18'	65	.....	35	35	55	65

* This pile was driven butt down. † Driven in the usual way. ‡ Driven with Follower. § Driven without Follower. NOTE.—Weight of hammer, 2,600 lbs.

SUMMARY OF WORK OF ONE DRIVER.

DATES.	No. of days.	No. of piles driven.	Lineal feet of piles driven.	No. of piles driven daily.	Lineal feet of piles driven daily	*Contractor's cost of driving.	Average cost of driving per lin. ft.
1884.							
Piles from 23' to 45' long, Dec. 11 to 31	10½	203	6,520½	19⅓	621	$451.43	$0.06969†
Jan. 1 to 5 and 10 to 14	5⅝	134	5,785	23 3-10	1,026	212.57	0.0367
Piles over 45' long.							
Jan. 5 to 10 and 14 to 31	14½	364	21,535	‡25 1-10	1,485	539 61	0.025 6
Feb. 1 to 28	19⅓	379	25,036	19 1-5	1,268	747.71	0.0298
Mar 1 to 5	3¼	73	4,789	22½	1,473	135.75	0.0284
Average cost per lineal foot, piles less than 45 feet long							$0.0542
" " " " " over " "							0.0277

* Contractors, Winston Bros., of Minneapolis. Actual cost of driving after the piles were delivered at the pile-driver.
† Some delay on shore by frozen ground.
‡ The best record was 130 piles = 6,600 feet in four consecutive days.

TOTAL PILING USED IN STRUCTURE.

	Number.	Lineal feet.	Average length.
Piles less than 51' long	1,197	51,758	
" from 51' to 60'	595	33,104	
" " 60' to 70'	547	36,248	
Total	2,339	120,110	51.3

DISTRIBUTION.

	Number of piles.	Total length.	Length below cut-off.	Length cut-off.	Average cut-off.
Pile bridging	1,376	71,607	64,782	6,825	4.96
Foundations, 7 piers	461	31,787	11,001	10 786	23.39
Draw protections	316	15,999	14,815	1,184	2.44
Temporary bridge	120	7,092	6,699	393	2.53
Other temp'ry work	66	3,715			
	2,339	120,110			

complied with or not. He cannot say at any time whether the contractor is getting on properly with his work, or whether he has a sufficient force to finish it in time. In all probability he will have to keep some of the contractors, waiting several days before he can set them to work; for they will all be clamoring for stakes at the same time. He will be behindhand in giving his estimates. When notified to come and receive a piece of work, he will be a week getting there, delaying the contractor and all his force. These are felt to be grave hardships by the contractor—and let it not be forgotten that they must be paid for by the Board in one way or another—in defective or fradulent work or in high prices, for contractors are shrewd men, and will "get even" for bad treatment if they can.

"An insufficient engineering force is an especially grave mistake when large and important levees are in course of construction, and particularly when the contract price is a low one. The temptation in this case is very great to dawdle along with the work in the hope of subletting parts of it at small figures, or of labor becoming more plentiful and cheaper, or of the winter being unusually fine, or of the spring flood being later or lower than usual, or some other of the thousand chances that may happen. It is the experience of every levee engineer that it takes constant watching and not a little exercise of authority to keep an artful and unscrupulous or even a dull and slow contractor up to his duty when the margin of profit is small. Order him to increase his force to a certain standard and he will do so, only to let it drop back again if you are absent too long. There is no alternative between constant and close supervision or else putting a force on the work at his expense. This is an expedient to which the engineer resorts with reluctance. If adopted too early, the retained percentage may not be sufficient to insure the Board against loss. If put off, there is serious risk (as has often been proved) of being too late. The result is, increased expense in the way of protection levees, &c., if not absolute disaster. In either case the end is generally ruin to the contractor, if of moderate means.

"Now, apart from any higher views of humanity or morality, it is the worst policy imaginable to ruin contractors, especially those who have taken work at low figures. On the contrary, it should be our aim to help them forward in all legitimate ways. The result will soon be seen in the reputation of the Board for fair and considerate treatment, in increased competition and lowered prices. A difference of about one cent a yard on the work of each year would pay all the salaries and expenses of the Engineering Department for that time.

"If it be not sound policy to have an insufficent force of engineers, still less is it advisable to be parsimonious in the matter of salaries. A good engineer must of course be of inflexible integrity, sober, truthful, accurate, resolute, discreet, of cool and sound judgment, must have command of his temper, must have courage to resist and repel attempts at intimidation, a firmness that is proof against solicitation, flattery or improper bias of any kind, must take an interest in his work, must be energetic, quick to decide, prompt to act, must be as fair and impartial as a judge on the bench, must have experience in his work and in dealing with men, which implies some maturity of years, must have business habits and knowledge of accounts. Men who combine these qualities are not to be picked up every day. Still they can be found. But they are greatly in demand, and when found, they are worth their price; rather, they are beyond price, and their value cannot be estimated by dollars. While the pay of good engineers is high, it is not inordinate, but the contrary. The prices paid by the Board are not greater but are rather less than paid by the U. S. Government and by others who employ engineers of a high grade—and there is not a man in the employ of this department who has not had the offer of an equivalent or greater salary elsewhere.

"Real economy is most praiseworthy. This consists in avoiding waste and mismanagement, in seeing every dollar spent to advantage. To practice it is the true interest of all administrative officers, and if they are wise enough to discern their interest, it is also their object. They have nothing to gain by prodigality. They can make no more than their salaries. Their reputation depends upon economical administration. It takes some courage to run counter to popular opinion, and incur expenses the necessity for which is not generally appreciated. Still, it is part of the duty of a good officer to do this, if he thinks it best for the interest of the service; and he will not shrink from it, looking always to the supreme end in view—the successful accomplishment of his work."

Engineers Surveying Instruments—Their Construction and Use.

I.

Written for ENGINEERING NEWS.

BY L. O. BAKER, C. E.
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It is proposed to give a series of articles on the best methods of constructing, adjusting, and using the different engineering field instruments. The intention is to make the language so simple and clear that all can understand, and at the same time make it something more than an elementary discussion, and not a re-statement of matter found in ordinary text books and engineering manuals. It is not necessary to dwell upon the importance to the engineer of a knowledge of the best forms of construction and of a thorough understanding of the principles which govern the adjustments of his instruments, and of course the engineer should be an expert in handling his instruments.

THE PLANE TABLE.

This instrument is not properly appreciated by the engineering profession. In a general way it is understood to be employed in the surveys, geodetical, topographical and geological, made by the general government, but it seems to be very well understood that the plane table is both useful and available in many cases in ordinary practice. It is frequently the best means of obtaining the plat and area of the irregular tracts that occur in ordinary land and city surveying; it is valuable in making plats of parks, cemeteries, mining property, system of ditches, etc. It has the great advantage of dispensing with all notes and records of the measurements, since they are platted as they are surveyed: it thus saves time and lessens the possibility of making mistakes.

It will be shown later how the simplest form of the plane table, combined with an ordinary transit or level, affords an easy, rapid, and accurate method of making preliminary surveys for railroads, for tile or open ditch drainage, for water supply, etc.

2. CONSTRUCTION.—"In its simplest form, the plane table consists of a drawing board fixed on a tripod, on which lines are drawn to represent the direction of any object as indicated by a ruler placed so as to point to the object. Any other parts are mere additions to render the operations more convenient and precise." The ruler is usually a scale of equal parts with a feather edge; at each end it carries a sight. The ruler and sight together are called the alidade. Fig. 2.

A very good plane table can be made very cheaply, if the engineer has a transit or leveling instrument, in which the upper part is detachable from the leveling screws. This requires a good drawing board, say 18 by 20 inches, to the under side of which is screwed a casting of iron or brass similar to Fig. 1. The conical portion, *a*, should be made to fit the socket from which the axis of the level or transit is taken; the cylindrical portion, *cc*, should fit in the lower clamps.

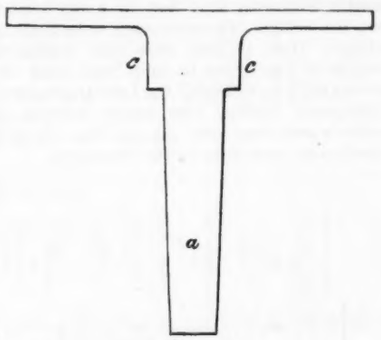

FIG. 1.

3. In the best form of the plane table, such as are used on the elaborate topographical surveys conducted by the general government, a telescope with vertical arc and stadia hairs is substituted for the sights. These modifications add very considerably to the range and precision of the instrument, but it is too elaborate and expensive for many of the uses suggested above. A plane table of this form is virtually a transit in which the horizontal circle is replaced by the drawing board, the lines being drawn upon the paper instead of being read from the graduated limb. The principal advantages of this form of plane table may be obtained by using a transit with stadia hairs in connectiou with a drawing board and protractor. The form of the instrument used by the U. S. Coast and Geodetic Survey is illustrated and fully described, and the method of adjusting and using it explained in the reports of the above survey for 1865 and 1880. The article is also published separately, and is for sale by book dealers under the title, *The Plane Table and its uses in Topographical Surveying.*

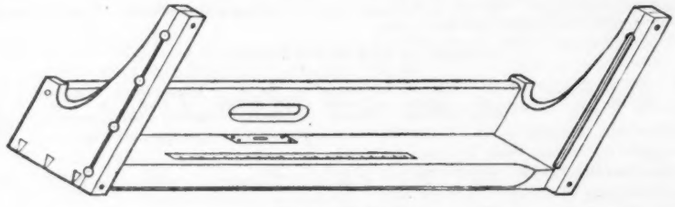

FIG. 2. THE ALIDADE.

4. ADJUSTMENTS.—The adjustments are few and easily made, and having once been made are not likely to get out. They are; 1, the feather-edge of the ruler should be a straight

line; 2, the sights should be perpendicular to the top of the board; 3, the table should be horizontal when the level bubble is in the middle of its race. The third is the rigorous requirement, but as the simpler form of plane table can be sufficiently accurate without any level, it is almost unnecessary to describe a method for testing this condition. However, to make the test, place the alidade on the table, and tip the table until the bubble is in the middle; reverse the alidade end for end; if the bubble is not in the middle the above condition is not satisfied. Even if the above condition is not satisfied, it may be adjusted so as to do perfectly accurate work. To adjust it, mark a point half way between its first and second position; when the bubble stands at this point the top of the board is horizontal.

5. FIELD WORK.—Since there is such variety in the kind of work that may be done with the plane table, and in the method of doing it, it will not be possible to give any explanations of the method of doing field work in a newspaper article. It is enough to say that the instrument is very flexible in its adaptation to different kinds of work, one valuable feature being that the work can generally be checked at every step. Gillespie's Land Surveying gives a few hints on the determination of areas with the plane table, and other methods will readily suggest themselves after a little practice.

6 LIMITS OF PRECISION.—Since there is such variety in the kind of work, in the method of doing it, and in the conditions under which it is done, it is scarcely possible to state definitely the degree of precision to be obtained with the plane table.

The ordinary class work of the author's students in measuring the three angles of a triangle and four angles around a point, using a wooden alidade with slit and string for sights, gives an average error, for sighting, marking, and scaling off, of 1 minute and 44 seconds *per angle;* this is equivalent to a probable error of 88 seconds per angle. Under fair conditions the maximum error of an angle ought not to exceed one or two minutes. An angle can be measured by repetitions with a plane table with surprising accuracy.

A *plat* taken by progression or radix progression, to a scale of 2 inches to a chain, should close with a maximum error of about ¼ of a link per chain; with a little care this error may be much reduced and is often inappreciable. *Areas* should be found by this plane table with an average error of one in 5,000 or 6,000.

An engineer will find an instrument made as above very useful in many ways and worth many times all it costs.

The Spongilla in Main Pipes.*

BY DESMOND FITZGERALD M. A. SOC. C. E.

Great attention is paid by hydraulic engineers to the designing of dams, aqueducts, reservoirs, etc.—structures connected with the sources of supply; but the question may well be asked: Is proper attention given to the pipe or distribution system?

Experiments and formulas we certainly have on the flow of water through pipes, but the writer is inclined to believe, as the result of observation, that when the water has been once turned into a pipe system, little more attention is paid to the condition of the pipes. Sometimes, it is true, small pipes fill up entirely, and then specimens are exhibited showing the growth of tuberculation. Again, the water becomes bad in one street while it is good in the adjoining neighborhood, and the result is attributed to some mysterious agency. It is the belief of the writer that one of the great steps in advance that will be made in the years to come in the designing of pipe systems will be the introduction of facilities for cleaning out the pipes at stated intervals of time. This will be found necessary, not so much for the purpose of restoring the normal capacity of the pipes, as for maintaining the purity of the water.

A few years since, the writer was standing by the side of Prof. Remsen when he made the discovery of the *spongilla* as being the principal source of trouble in the Boston water.

Many excellent engineers have doubted the influence of the sponge, but in a somewhat varied experience in different sources since that time, the writer is inclined to give more and more weight to the conclusions of Prof. Remsen. Not to go into the question of the growth and development of the *spongilla* in lakes, reservoirs, etc., which may be made the subject of a future article, the writer would like to call the attention of the profession to the fact of the growth of the *spongilla lacustris* in the pipes of a water system. When the sponge is present in the sources of supply, pieces of it find their way into the pipes. These, decaying, give an offensive cucumber or fishy taste to the water. This accounts for the fact that the bad taste is almost always detected in the city a few days before the taste is found in the reservoirs. The sponge is really an animal and lays eggs, which float down with the water and attach themselves in large quantities to the interior surfaces of the pipes.

More accurately, these reticulated masses are the *statoblasts* of the sponge. The forms which these eggs take are very curious. They mass themselves in traceries like lace-work, generally from the size of a silver half-dollar to the size of a plate, and the exterior boundaries generally take a circular or oval form. Soon the eggs begin to bring forth the sponge, no matter what the pressure, and a soft velvety, light green sponge begins to grow in circular patches. This growth, if left undisturbed, gives out long fingers of sponge.

With life there must be death and decay, and with the decay of the sponge comes the cucumber taste.

The writer has seen large mains, under a pressure of 100 feet, where the entire surface, as far as examined, was filled with offensive masses of sponge closely packed between and around the tubercles. He has also seen them in all the stages of growth. Within a few days a break in a 48-inch main gave an opportunity to examine the sponge in the company with Prof. Hyatt, who recognized the young sponge as *spongilla lacustris* var. *flexis pina*. Flushing will not remove this growth. Some form of scraper or wire brush is necessary. In Halifax, Mr. E. H. Keating, M. Am. Soc. C. E., has perfected and used extensively an apparatus for cleaning out pipes, but one of the difficulties of this form of scraper will probably be found to be the protrusion into the interior of the pipes of service-pipe connections, etc., which has been found to be necessary to keep rust from covering them. It would seem, however, that some form of brush might be devised which would do the work effectively.

DISCUSSION.

JOSEPH P. DAVIS, Vice-President A. Soc. C. E.—The result of a good many experiments in Boston has been that, under the conditions which produce what is known as the cucumber taste, if the pipes are blown out the bad taste increases. The *spongilla* was discovered to be the cause of the cucumber taste some few years ago by Prof. Ira Remsen, of the Johns Hopkins University. There was a comparatively small amount of it in the pond where it was discovered; one could hardly believe such a small quantity could produce such a bad effect. The presence of a sponge-like growth in the Cochituate conduit was noticed soon after Cochituate water was introduced, but although in 1854 (I think that is the year) the cucumber taste rendered the water unfit for use, no one seems to have suspected that the taste arose from the *spongilla*.

E. B. DORSEY, M. Am. Soc. C. E.—Was that undoubtedly the cause of the bad water?

MR. DAVIS.—There is, perhaps, some doubt about it. But we are inclined to believe that that was the cause. It is very curious how the presence of this taste is usually first made known. In 1876 it occurred something in this way. A consumer would come into the office and say the water supplied to his house was exceedingly bad. On asking him where he was now getting his water from, he would say, from his neighbor. "Was that good?" "Yes." Naturally we supposed a fish had got into his supply pipe. During the day, probably a number of persons would come in complaining of their water, whereas their neighbor's water was good. In the next twenty-four hours the whole section would be troubled, and within two or three days it would be all over the city. In that year (1876) no bad taste was found in the reservoirs for two or three days after the discovery in the city. I do not know what the life of the animal is, but the effect produced upon the water by its decay lasts sometimes two or three months. The supply for Boston was (in 1876) brought to the city by a single aqueduct and delivered into two reservoirs, one of which, the Chestnut Hill reservoir, had two basins; the lower was quite a large one, and as clean a one as I ever knew of. The first knowledge of any trouble in the city was had as I have described it. I was out some two or three days trying to find the source of the trouble, and found it in the lower basin of this reservoir. The supply was shut off for some three or four months, when it was again turned on. It did not seem possible there could have been any growth in the basin. Since that time Prof. Remsen has found this *spongilla* growing in the ponds.

J. J. R. CROES, M. A. Soc. C. E.—In cases where this has grown in the pipes—the supply pipe—how long does it last? I suppose it has a growth and death, and death, and decomposition comes on?

Mr. DAVIS.—The taste sometimes lasts for two or three weeks in the pipes. In the reservoir, where it was not carried away by the current, it lasted some two or three months in the winter.

Mr. DORSEY.—Does it recur at the same time of the year?

Mr. DAVIS.—I think not.

THEODORE COOPER, M. A. Soc. C. E.—Can you distinguish it with the eye?

Mr. DAVIS.—It attaches itself to the rocks and grows like sea-weed.

Mr. DORSEY.—Is it green?

Mr. DAVIS.—When fresh and alive.

J. C. CAMPBELL, M. A. Soc. C. E.—Has there ever been anything done to prevent it?

Mr. DAVIS.—When it first occurred a thorough blowing out of the pipes was made, but it resulted in an increase of the taste. Of late years, finding that this only made it worse, we did not do it.

Mr. CROES.—Has this ever occurred in a supply that is taken from water not exposed to light and air. If I am not mistaken it only occurs where the water is exposed to light and air.

Mr. DAVIS.—I don't think I ever heard of a case where the water was not exposed that it became bad from this cause.

Mr. DORSEY.—Have they ever tried the ordinary sand or gravel filter?

Mr. DAVIS.—In Boston? No, sir; not for the purpose of taking this taste out. Experiments have been made for other objects. Of course, it takes out little or nothing held in solution. When you get the taste you cannot filter it out. In the early days of the Cochituate supply, sponge filters on the house faucets were very generally used, but when the bad taste developed in 1854 they had no beneficial effect. Exposure of the water to the air for a short time, in small quantities or boiling, usually destroys the taste.

*Read October 15th, 1884, before the American Society of Civil Engineers and published in *Transactions* May, 1886.

To Fortify British Columbia.—A party of Royal Engineers, under command of Lieut.-Col. O'Brien, have left Halifax, N. S., for British Columbia. They go to look over the ground with the view of reporting to the imperial authorities as to the best manner of fortifying the Pacific coast.

Railway Extension in South Australia.—The Government of South Australia has accepted the tender of Miller Bros., Adelaide, for the construction of the railway from Palmerston, to Pine Creek, for the sum of $3,027,120, with the option of employing Chinese labor; the lowest tender providing for doing the work with European labor only, by Robinson & Haig was $3,456,340.

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We publish this week a double page illustration of the New High Service Pumping Engine No. 5, St. Louis Water Works.

PROBLEM for Mr. Fforde, M. I. C. E. If a hornet's nest stops an Engineering party two weeks,* how long would a band of Apache Indians stop the same party?

THE River and Harbor Bill was signed by the President on Thursday. It appropriates $14,475,900. Very properly the President consulted General Newton, Chief of Engineers, rather than the editors of the New York daily press, a class of people who are more interested in dog fights and lawn tennis than they are in the material development of their country, The appropriation ought to be fifty millions.

WE print on another page a review of the 2nd. Annual Report of the Supervisory Board of Commissioners of the New York Municipal Civil Service. It is a pleasure to note both the improvement in the quality of the questions for examinations and the economy with which the service has been performed. But we think all our readers will agree with us that a decided mistake has been made in giving efficiency and accuracy in work a value of only 15 in 100 while technical knowledge, which is in such large supply and can be obtained at such reasonable terms is valued at 50, equalling experience, efficiency, and character for maintaining discipline, etc.

*Minutes of Proceedings Inst. C. E., Vol. LXXXV Part III. Page 94 Discussion on Economical Railways.

Does Civil Engineering Pay?

I am a young man twenty-four years of age, received a good school education, and attended the Scientific Class in Cooper Union and the evening High school; was for three years in commercial business in New York, and one year in an architect's office, and five years ago secured an engagement as rodman on a railway in the Northwest. I was employed until early last year on both location and construction, and had charge of several heavy divisions and bridges. Have been trying the past year to secure a position at any branch of engineering, but have been unsuccessful. I had resolved to make Civil Engineering my means of support during life, but my inability to secure employment rather discourages me. I am without capital and influence, have several persons dependent upon me, and am entirely dependent upon what I earn for a living. Now is it advisable to permanently enter other business, and give up Civil Engineering, or wait until the present depression is over and then engage in my profession when the opportunity arrives?

The above straightforward letter is a fair sample of many more which reach us every year. It is not the rule, however, that the parties writing us are as well equipped intellectually and with as much practical experience as our present correspondent, who gives his address in New York city, and who moreover writes so neat a hand that we feel at once a surprise that his services are not in demand.

There are very few civil engineers at 24 years of age who can claim to be possessed of "capital and influence"; if they have good health and a good education at that age they usually feel tolerably buoyant, and disposed to take a very cheerful view of the immediate future. But this might not be the case where our young engineer had "several persons dependent upon" him, and, while it will undoubtedly develop all the nobleness of a man's nature, if he have any nobleness in him, to feel that he must be the "breadwinner" for those whom he loves, or who may, by the force of circumstances be dependent upon him for support, yet it is undeniably a serious drawback to success as a civil engineer, who cannot in the early years of practice claim any place as his permanent home, and who in choosing his profession must accept the alternative of short engagements and possibly long intervals of unremunerative waiting.

The history of civil engineering as a money making profession in comparison with other branches of business is, that, in case of a graduate of an engineering class, we will say—he very soon finds a situation at some price for his services, usually more than they are worth, and for a few years advancement is rapid until a salary of between $1,200 and $1,800 is reached, at which point he sticks the remainder of his life unless he is especially fortunate in his opportunities, or is of his own abilities able to go up among the better paid ones. The average of lawyers, doctors, or ministers do not do so well, although individuals in these professions win prizes that are quite out of the reach of the best paid civil engineers.

In merchandising and speculating one is apt to think that more prizes are to be drawn than in the professions, but this conclusion is not borne out by statistics. And close study of the sources of wealth does not point inevitably to any particular business as the most profitable. If it did, the immediate rush in that direction would soon bring it to the normal level of other trades.

There are no civil engineers in the poor-houses, and no paupers among civil engineers. "Dead beats" are rare, very rare, and soon disappear from the ranks of the profession forever: simple honesty as a principle and rule of life, is a professional characteristic, the accepted vicissitudes of their calling makes economy in living an early and life long habit, and induces the forethought w provides for inevitable "rainy days."

Our opinion is, that our young correspondent has as good a reason to hold on to Civil Engineering for a living as to lose time in experimenting in some other business. It is discouraging, and we most heartily sympathize with him, as we do with all those who are able to work, and willing to work, and on whose earning ability depends the comfort, and the very lives often of others, yet to whom the prospects all around seem as a huge wall over which they cannot climb.

There is nothing to do but to persevere, to study, to be on the keen watch all the time, and the hour comes when the tide turns and the weary waiting of the past becomes the welcome fatigue of present employment.

There are men, however, whom neither education or opportunity would make successful engineers; they should seek employment elsewhere, and where great success is perhaps patiently awaiting their coming.

PERSONAL

F. HODGMAN, C. E., of Climax, Mich., is engaged to prepare plans for Water Works for Niles, Mich.

JOHN F. LELAND, has been appointed auditor, and John I. O'Daly, Chief Engineer of the Fort Worth and New Orleans R. R. Co. Headquarters at Fort Worth, Tex.

The Aqueduct Commissioners on Wednesday adopted the report of the Committee on Construction in favor of dividing the new aqueduct into five engineering divisions.

WM. P. SHINN, M. A. Soc. C. E., has been in Burlington, recording the points developed by the extensive brake tests which have been carried out at that place.

WILLIAM R. HUTTON, M. A. Soc. C. E., late Consulting Engineer New Aqueduct Commission, has been appointed Chief Engineer of the Harlem River Bridge, vice Wm. J. McAlpine, resigned.

COL. W. M. PATTON, who was Supervising Engineer of the Susquehanna and Schuylkill river bridges on the new line of the B. & O. R. R., is now at Mobile, Ala., engaged on the Mobile and Grand Trunk R. R.

CAPT. T. W. GILL, who has been Superintendent of the Hannibal (Mo.) bridge since its construction, sixteen years ago, resigned his position July 28. He was succeeded by ROBERT RICHARDSON, who has served as engineer at the bridge for a number of years.

COL. CHARLES L. SCHLATTER, late General Manager and Vice-President of the Brunswick and Western R. R., and formerly, Chief Engineer of the State of Pennsylvania, died at Brunswick, Ga., on Wednesday afternoon in the seventy-ninth year of his age. COL. SCHLATTER was one of the oldest civil engineers of note in the United States.

STATE ENGINEER SWEET has changed his canal force so that it is now constituted as follows:

C. L. Johnson of Albany, promoted from assistant to resident engineer; Augustus P. Clark of Cazenovia, assistant engineer; Frank N. Kimball, Troy, leveller; Lawrence Gaul, Albany, rodman; Charles H. Whitbeck, Albany, rodman; Fletcher W. Battershall, Albany, John C. Brady, Utica, James Shanahan, jr., Tribes Hill, chainmen.

When the patent granolithic sidewalk pavement is first put down it is very sticky, but it hardens quickly. This is why a young couple of Bridgeport who stood on a fresh slab of the composition while bidding each other good-night, had to be dug out with a pick-axe. Their shoes were ruined, but they were very grateful to the night watchman who released them and who promised not to tell.

MR. MANN, City Engineer of Holyoke, Mass., has invented and applied for a patent on an architect's table. The table stands on an iron frame about the height of an ordinary table, and by means of an attachment at the sides it can be elevated or depressed at any desired angle, or it can be turned completely over and the other side used. The work is done on a band of linoleum, which works like an endless belt, a drum on the inner side of the table controlling the belt, and

the sheet of paper bearing the plan can be made of any desired length. The table is about 4½ feet long by 3 feet and 4 inches wide.

SAMUEL J. TILDEN died on the 4th inst. His successful efforts in breaking up the canal ring in this State were the most material contribution to good government of the last twenty years, and have placed New York state engineering on a much more respectable basis than it occupied before. A large part of his fortune—supposed to be about ten millions of dollars—was made as a railroad lawyer.

WHO WAS THE SKILLFUL ENGINEER?—The late MR. TILDEN, in making some improvements recently, had need of a skillful engineer to lay off some ground for him back of his farm. One day the Governor drove out to see how the work was getting on. The workmen, as they usually do at his approach, took off their hats. MR. TILDEN spoke to Miss Gould, who asked the engineer how the work was coming on. The man took off his hat, walked close up to the side of the T cart where MR. TILDEN was sitting, and yelled:

"We're coming on all right, Guv'nor," and added in a low tone of voice to himself: "Why the devil don't he stay in the house?"

MR. TILDEN'S eyes sparkled, and laying his left hand on the man's sleeve motioned for him to put his ear down to his mouth, and in a low voice said:

"My hearing is very good."

The man's face was a picture; white, red, then white again. Then timidly lifting his eyes to the Governor's face, he took off his hat and asked his pardon. MR. TILDEN simply smiled, and motioned for Riley to drive on.

LT. COL. JUNIUS B. WHEELER, late Professor of Civil and Military Engineering at West Point died on the 15th ult. at Leander, Caldwell Co. N. C. Col. Wheeler, graduated in 1885. The following year he was transferred to the Topographical Engineers and served until 1859 in Oregon and Washington Territory: in October of that year he was stationed at West Point as assistant professor of mathematics. In July, 1860, he became first lieutenant. During the war of the rebellion he served as assistant topographical engineer of the Department of Virginia, and subsequently, after his promotion in March, 1863, to Captain Corps of Engineers, as chief engineer of the Department of the Susquehanna and the Division of the Missouri. He was brevetted major for his services at the battle of Jenkin's Ferry, and lieutenant colonel and colonel for services during the rebellion. At the conclusion of the war Colonel Wheeler was engaged in disposing of engineer property in Missouri and Arkansas, acted as assistant engineer in the examination of the Mississippi levees from Vicksburg to New Orleans, made the survey of the extension of the Capitol grounds in this city and acted as superintending engineer of harbor improvements on Lake Michigan. In July, 1866, he was promoted major Corps of Engineers. In 1871 he accepted a professorship at the Military Academy where he remained until placed on the retired list at his own request, with pay of Colonel, in September, 1884.

The Denver Convention of the American Society of Civil Engineers.

Special Correspondence ENGINEERING NEWS.

Probably the most western of westerners will now admit that the American Society of Civil Engineers has "been west." Three years ago the members and their friends, while enjoying the hospitalities of St. Paul and Mineapolis, began to consider themselves "out west"; but, as the inhabitants of that region scorned the imputation of being western folks, a few of the party, determined to go west indisputably, had to organize an expedition to Yellowstone Park. But the society as a body, claiming to be in the forefront of modern progress, could not longer rest even under the bare suspicion of being merely "eastern," and so the month of July, 1886, finds them, a convention of "tenderfoots," on the slopes of the Rocky Mountains. A few, aspiring to still higher distinction as "old stagers," went on in advance or tarried behind to see the country in an *unconventional* way.

It was eminently proper that the civil engineers and their friends should enjoy the culmination of the skill, inventive effort and patient toil of themeselves and their professional brethern. Hence, they had the best of means and appliances for railway travel which the world can provide; Pullman hotel and Wagner palace cars, with every convenience on board so that the traveller need not leave the train day or night; luxurious and well served meals eaten at ease while speeding over the standard road-bed of the N. Y. C. & H. R. R. at the rate of 50 miles an hour; the best modern equipment and train service, by which the distance from New York to Buffalo, 440 miles is traversed in 9 hours, and to Chicago, 980 miles, in less than 25; the world renowned scenery of the Hudson and the picturesque views of the Mohawk valley to stimulate sentiment and rouse the poetic instinct, and as it is believed that most of the party were susceptible and visibly moved by some things which cannot be embodied in estimates and specifications, it was right that all these and many other of the "best things" should be enjoyed by those who are leaders in the material development of the age.

Of course, it would be highly irrelevant to dwell upon scenes and incidents which pertain to the merely *eastern* part of the journey e. g. the night on the L. S. & M. S. and the morning ride through northern Indiana, the approach to Chicago and the three hours spent in that metropolis which now claims a population of 700,000, the afternoon flight through thriving communities and rich farms along the C. B. & Q. in Illinois, the stepping over the Fathers of Waters at Burlington after dark, the second night of oblivion (?) while traversing southern Iowa (broken, it is true, by maledictions on the inventor of the device for automatic and continuous ringing of the engine bell, and on the legislators who made such ringing compulsory), etc.; suffice to say that the second morning found the expedition at Pacific Junction in the Missouri bottom, and four miles east of the river, while on the east and west extend the bluffs, miles apart, suggesting that the river of to-day, great as it is, may be only a puny and degenerate descendant of a mighty ancestor. Such reflections are rudely interrupted by the setting of the tables for breakfast and the sudden consciousness of the existence of a stomach which has no appreciation of scenery or past geologic time. Reinforcements from Chicago and St. Louis had duly joined the party on the previous day, so that there were now three parlor, and three hotel cars, and a baggage car containing those awful trunks stuffed with clothes and fine feathers, the train carrying in all about 125 ladies and gentlemen.

Crossing the "great muddy" by the famous Plattsmouth bridge, built by a distinguished member of the society, the ascent of the great inclined *plain* was begun. The casual observer would suppose this magnificent region, embracing eastern Kansas and Nebraska, to be essentially level. In some parts the land stretches away in great billows of verdure, crested and furrowed by lines and patches of recent timber growth, a very picture of fertility and productiveness. In other parts it appears like the calm sea, level and illimitable. The smiling surface is checked by vast fields of waving crops and dotted with low farmhouses, stacks of hay or grain and suggestive windmills, and when a sense of monotony begins to oppress the beholder, fresh interest is aroused by towns and villages which are reached and passed at intervals. Lincoln, the capital of Nebraska, is especially interesting as a typical city of the plains. Last year it contained 20,000 inhabitants, this year 29,000. A short stop enabled the tourists to notice many evidences of healthy growth, wealth and western "push," in its buildings, streets, street railways, etc. But the illusion of a level county is soon dispelled with an aneroid barometer in hand. The pointer is seen to creep slowly backward. During the afternoon of the third day out a convention of aneroids was held in one of the cars, and it was found that the altitude was quite various, all the way from 1,650 to 2,680 feet above the sea. Of course, all had been "carefully compared with and set by a standard" before starting, and the faith of each holder in his own aneroid must not be rudely trifled with, so the convention adjourned without a unanimous verdict, but with a prevailing opinion in favor of about 2,200 feet and a rise of the *ideal plane* at the rate of 8 or 9 feet to the mile.

As the day wears away the aspect changes. Cultivated areas become few and far between. Trees appear only along the line of some stream. Isolated habitations are not seen. The occasional railway drinking-tub (*alias* water tank) is the nucleus of a small hamlet of shanties every third one of which is a "saloon." Even the places with high sounding names now prove to be groups of low broad dwellings, suggestive of squatters and "very early" colonists, the best three out of five being advertised by big letters as "Restaurants." Variety is offered by occasional houses of adobe with thatched roofs, or turf cottages with board roofs, or—but all the permutations of adobe, thatch, turf and boards are not to be seen. The windmill speaks of lack of confidence in the rainfall. The parched earth and the apology for vegetation, a scant and stunted growth speak of actual drought. Wire fences, running parallel with the track, or stretching away toward and over the horizon as though they would reach around the world, suggest vast ranges for cattle, with "feed" in the inverse ratio to the area. There is not even "the shadow of a great rock in a weary land." A naked wilderness, an all but rainless region, well named by the pioneers, "The Great American Desert." And thus night falls, while the hurrying train continues to measure the tedious miles along the rails, and the tired engineers creep into their berths and try to become insensible to the clatter of the wheels and the general racket.

'T'is morn, but scarce yon rolling sun can pierce the "car window, ere an innocent tenderfoot looks out expecting to see some evidence of approach to the mountains, since Denver must be reached in less than two hours. But no, the same old prairie waste all around; prairie dogs gazing a moment and then making comical flight to their burrows; owls sitting in dignity over some of the portals of these tunnels in miniature, jack rabbits, dwarf sunflowers, cactus plants and wild sage, afford indeed a passing interest, but give no promise of the journey's end. No foot hills in sight, but plenty of ant hills; not a sign of a mountain, although the aneroid indicates an altitude of 5,000 feet. At last along the forward horizon a dark haze is seen; soon an outline as of low hills, then the hills grow, by and by streaks of white and separate peaks appear; then a long jagged outline, growing more distinct each moment. These are the first glimpses of the Rocky Mountains, distant 75 to 80 miles and more. Then there is gradually revealed a gorgeous vision of white and grey peaks, as of silver and gold, bathed in the morning sunlight and clearly defined against a cloudless sky. This picture of glory is separated from the sharp line of the prairie horizon by a bank of blue, above which it rises like the view of the Delectable mountains to Bunyan's pilgrim. It is as if we are approaching the edge of the world, and away beyond, with the blue of the atmosphere hanging over a vast intervening abyss, lies another world, now seen stretching far to the north and south. Little by little the prairie horizon begins to approach, finally the train rolls over

the crest of a great prairie wave, and almost in an instant bursts upon the vision, a grand view of the valley of South Platte and the "crest of the continent." The river is marked by a green and serpentine line of trees miles away; another train is seen creeping along further down the gentle slope, the glorious mountains in majestic array make a background of splendor in the west, the dark body and uneven outlines of the foothills serve to correct the perspective and give an idea of distances, while only a few miles away is Denver itself, embowered in green and made beautiful by the unclouded sunlight.

Denver is a phenomenon. "Rome was not built in a day," but if we compare the history of 1,000 years with that of 20, Denver is a city grown in a day. And solid, substantial growth it is, which the visitors had every facility to see, through the courtesy of the citizens. Nearly fifty private carriages and spans of horses were placed at the disposal of the convention during part of a forenoon. Beautiful streets lined with trees which drink from running streams, one along every sidewalk; solid blocks of lofty stores and business houses, elegant hotels, large and strictly first-class; every style of dwelling-house, from the neat cottage to the finest mansions amid flowering terraces and tree-lined walks, architecture of which any city might be proud, promoted as it is by convenient quarries which furnish all the best varieties and qualities of building stone, magnificent public buildings, schools concerning which the late Mr. J. D. Philbrick, the veteran educator said: "It is pretty safe to say that the creation of a system of schools on so large a scale, of such exceptional merits, and in so brief a space of time, ten years, is a phenomenon to which the history of education affords no parallel," an ample water supply pumped from the Platte river by the Holly system, an excellent system of sewerage; many miles of street railways (and a "circle railway" which is yet a tangent), electric lighting for the streets, numerous and diverse industries, sixty-nine church societies and many large church edifices, a very efficient engineering department, and last, but not least, a local society of civil engineers; these, and a host of other features of which space forbids mention, are all the outcome of 20 years, the highest evidence of a vigorous municipal life. A city of 65,000 inhabitants covers a spot which in 1860 was camping ground for Arapahoe Indians.

And Denver has always before it the grandeur of the radiant mountains—from Pike's peak on the south, sixty-five miles distant, to Long's peak on the north, fifty miles. The snow-clad peaks suggest something more than mere emotion, since they are the very source of life itself to the city. The melting snows maintain the streams which fill the river and the canals, and, after a course of scores of miles, are finally distributed in every street and by pipes to every house, so that each lawn and garden may be kept green by daily sprinkling. The rainfall is scanty and unseasonable, less than 15 inches annually. Denver may well say "I will lift up mine eyes unto the mountains* from whence cometh my help." A meteorological observer armed with the new rain band spectroscope, perhaps might see clouds of vapor—invisible to the unaided eye in that thirsty air—rising like incense to the sky.

As to the sessions of the Convention and what transpired, further details beyond what have been given already by another correspondent, are not called for at the present time. One difficulty not peculiar to *annual* meetings was re-emphasized by the discussion of one of the papers. Those who wish to discuss a paper which they have had no opportunity to peruse at leisure beforehand, but must gain their knowledge of it by what they can hear, and from cursory reading in some instances of printed copies distributed at the meeting, are at great disad antage, especially when doubtful or controverted points are involved. In some cases it is very difficult, if not impossible, to frame on the spot well-considered answers or arguments which one is willing to have appear in print. A resolution looking to a correction of this difficulty, so far as it admits of correction, was offered, and passed with great unanimity.

To the local committee and the Denver Society of Civil Engineers are due the hearty thanks and grateful appreciation of every visiting member, for their liberal hospitality and careful preparation for the meeting. Evidently the hosts had forebodings of an avalanche of questions and pictured to themselves each visitor as an interrogation point on legs. They prepared, with no small outlay of time, labor and money, a handsome book of 140 pages, with which to stay the first outburst of inquiry and avert immediate loss of their wits. This book, within an artistic cover designed by one of their own members, and elegantly illustrated by fifteen full page engravings, besides six maps and profiles, contains the latest facts and statistics concerning the State generally and the city of Denver; their history, industries, climate, the artesian wells, the sewerage system, the narrow-gauge railways, the coal mines, Colorado metals and their reduction, building stones, cement and fire-clay, oil, the systems of irrigation and the manufactures. Each visitor, receiving one of these, possessed at once both a key to the country and a greatly-prized souvenir of the trip. He was prepared thus for intelligent observation and hearty appreciation of all that he saw.

In and around Denver, and on all the excursions which were made the members became better acquainted with, and perhaps some studied for the first time, a branch of engineering comparatively new in this country, at least as to any scientific development. Our brethren on the Pacific coast have already tested its possibilities on a grand scale. This process of taking a full-grown river and reversing the order of its growth, this "appropriation," as the engineers term it, of a whole fork or branch at once; the conducting them through tunnels, and rock hewn open channels, or in earth built canals or timber flumes, along steep mountain sides, across wide valleys and over great sloping plains for scores of miles—from twenty-five to seventy-five in different systems; the division and subdivision into creeks, brooks, rivulets and rills, thus spreading the waters over myriads of broad acres and clothing the waste with fruitfulness; all this achievement of the hydraulic engineer threatens a startling alteration of our geography. For the capacity of the mountains to yield the water is limited, while the increasing population and continued reclamation of the wide wastes ever calls for more. The logical outcome, perhaps not very far in the future, is the complete arresting and absorption of the rivers. The Platte, the Red, the Kansas, the Arkansas and other streams, why not even the Rio Grande and the great Missouri?—will be distributed over wide areas of the plains, no longer able to devastate the land. Then, doubtless, the Father of Waters himself, having so many limbs cut off will be forced to behave himself.

Through the princely hospitalities of the Union Pacific and Denver and Rio Grande railway companies the visitors enjoyed about 700 miles of excursion travel around, along, between, among and over the Rocky Mountains, and through their cañons and defiles.

The trip to Greeley by broad guage road was broad-gauge road in all respects. The broad and highly successful results of irrigation from the Cache La Poudre river were beheld with great interest. Here is an oasis in the desert, and scarcely an oasis any longer; for irrigation and its results spread like a contagion, and from this center the area of fertility is reaching in the direction of the streams and along railway lines and out into the parched waste. The streets are broad and the elegant public and private buildings, with attractive surroundings, indicate that the people are broad-minded, foremost in pluck and intelligence. In a place where water must be everywhere, running on every square yard of cultivated land, it is broad-gauge policy to totally exclude alcohol, which is held to be the Devil in material disguise. Behold here a practical demonstration, an object lesson for Trades Unions and Knights of Labor. If they could only learn that there is an issue far more vital and far-reaching than any controversy between capital and labor; that capital cannot be an enemy, since the common weal of mankind compels essential unity of interest between the two; but that *the* question behind and before all these so often needless agitations, and taking hold not only of the affairs of this life but of the concerns of eternity, is the *saloon* question; if they would only overthrow the real enemy which robs them of money and character, and their families of comfort and happiness; then our broad and beautiful country would be able to show thousands of communities like Greeley. But, as it is, the American Society of Civil Engineers had to go 2,000 miles to find (in the direction of their travel) a place from which alcoholic drink is excluded. (At least that is the world-wide reputation of the town; and of course there were none of the visiting company who would have desired to know of any surreptitious "pipe line," by which the initiated may be supplied with forbidden drink, even if such exist. But it is believed that Greeley "prohibition" is more genuine than that of Maine and Rhode Island).

The excursion to Georgetown was a little ahead of the best Sunday School excursion, probably, that the Society ever attended, either individually or collectively. Having supplied the essential condition to the enjoyment of fine scenery, viz; a good breakfast, the convention, in a special train furnished by the U. P. R'y., started for Clear creek cañon. Passing through green fields of corn and alfalfa, yellow fields of grain and the smiling country along the Platte, a long curve soon turns the train mountainward and up the line of Clear creek. In less than an hour the foothills are reached and then comes the sudden transition from the cultivated plains, over which the railway commands a wide sweep, to the heart of the mountains as it were, a change which almost startles the traveler. Entering between two "mesas" or table hills or buttes, as through a gateway, the city of Golden stands revealed, lying as it were in a golden bowl which is a grand vestibule to the beckoning cañon beyond. The smelting works, the handsome brick buildings widely scattered, the University, the towering naked slopes to the westward along which an irrigating canal winds around like a materialized contour line, these are only a few features of a beautiful picture. "The site of Golden is the bed of an ancient lake which has left its smooth-washed boulders and water mark, the latter high up along the buttes. The cañon is a marvellous cleft. The sides, time-worn into a thousand grotesque forms, rise from

* New version.

500 to 1,500 feet. The sky is a narrow strip. Trees grow thick in places and crown a portion of the heights. In places there are intersecting gullies by which rivulets come silvering down and the sunlight is allowed to strike across the sombre cañon. On the way are dumps of famous mines and mills and Chinese sluice-miners hip deep in water." But it is useless to try to do justice to the experiences of such a day. A brief summary and a few quotations from a "folder', issued by the U. P. R'y Co. must suffice. By a tortuous course through a bewildering succession of gorges and defiles, at the Forks leaving regretfully the branch road and the possibilities of the ride to Central City of which we heard so much, creeping up, up, up on grades reaching a maximum of 1 in 33, Georgetown is reached and passed, and Silver Plume and an altitude of 9,050 feet attained.

"Georgetown has 4,000 inhabitants. It is built on a series of silver-bearing veins, and with lofty mountains pressing it closely on three sides, creating a cool and bracing atmosphere. Green Lake sparkles two miles away, and 2,000 feet higher. The road passes around the edge of the town, rapidly rising, till from the cars there is a panoramic view of the city. In reaching Silver Plume some of the finest engineering ever accomplished has been necessary. The road crosses itself by a crescentic bridge 300 feet long, and 90 feet high. First you pass under the bridge and, proceeding up the cañon, span Clear creek, and turn again directly towards Georgetown. A little more, and from the bridge you look down upon the old track, and down upon Georgetown, the eye taking in Devil's Gate and Bridal Veil falls. Again you are going away from Georgetown; again apparently bound for it. The road is a puzzle of spiked and bolted steel. Before the whistle sounds for Silver Plume the loop has been nearly duplicated (see p. 58.) From one point six distinct tracks are visible. They are all one. From the "Big Fill" Georgetown can still be seen, and the line of vision passing under the bridge of the loop. In conquering less than two miles of distance, four and a half miles of road had to be built. Graymont is eight miles from Georgetown, and at present the terminus of the line. Here horses are procured for Gray's Peak, whose sublime summit meets the clouds six miles away by road and trail. The ascent easy; the boundless picture beheld from the summit, magnificent beyond all words,—the mountains in marshalled hosts, the plains stretching away toward the horizon. The return trip is even more enjoyable. The engine does not make his laboring clamor. There are no dust and cinders. The curious statuary stands out in better relief, and the plains are reached all too quickly."

All the preceding quotation relating to the summit of Gray's Peak we took on faith, since one day's journey could not include so much; but the rest was completely verified. Stopping at Georgetown long enough to settle the dinner question and buy poor "specimens" from importunate small boys, a fine stretch of hard, dry, coasting down the steel rails was now in order for thirty miles and more. A half hour stop at Idaho Springs was utilized in visiting the hot cavern and getting an unpremeditated hot vapor bath. Of course the not-to-be-outdone people penetrated to the hot springs, imbibed the nauseating draught and called it good, with a serene consciousness of duty done.

Far up the side valley, and viewed between two mountains, as in a frame, rose the bare head of Old Chief, 5,000 feet and more above us. Old Squaw and Pappoose were out of sight, but just around the corner. All up and down the steep slopes of the winding cañon were scores of openings made by the eager searches for mineral wealth. Some of these at their dizzy heights dwindled to mere auger holes. And the scattered dumps, the trestles and lines of cable for telferage, reaching up to scale the steeps, the stamping works and other buildings here and there, the placer diggings sometimes worked by primitive see-saw machinery driven by rude water wheels, these and other evidences of the hard toil, the rough life and the disappointments of a miner's existence did not lead to sanguine reflections. By the wasting of thousands of lives in vain toil men learn that, as a rule, to dig a dollar out of the earth requires that an equivalent of a dollar or more in labor be put in: and that, in this pursuit, as in all others, *only a few get the big prizes.*

All these experiences served to prepare the guests for a series of revelations of still greater grandeur. A prolonged culmination of the trip was to be afforded by a swing-round-the-circle from Denver through South Park to Breckenridge and Leadville; thence, by the Arkansas river to Pueblo and Manitou. What this means can only be appreciated by one who has been there. Leaving Denver under immediate command of Supt. Choate, who, in the Georgetown trip also, was unwearied in his efforts to promote the comfort and safety of the entire party, which was now borne by two trains, a rapid ride up the South Platte, through cultivated lands, led us to the Platte cañon.

The great High Line canal far up on the steep south bank claimed attention. Concerning this typical example of hydraulic engineering in Colorado our invaluable monitor, the "Convention Hand-book," gives the following information:

"The engineering features of the canal are the dam in the river, the tunnel at the head of the canal, the flume in the cañon, and the large flumes crossing the various creeks in its course. The main dam is constructed of timber, 120 feet long and 14 feet high. At the western end of the dam is a spacious waterway, 24 feet wide, over walls the full depth of the dam and built entirely of masonry, the gates and fittings being of iron. The headgates proper, at the mouth of the tunnel, are 25 feet wide and 12 feet high with five openings, the gates being operated by screws. The tunnel is 600 feet long, 20 feet wide and 12 feet high, with a grade of 5.28 feet per mile. Starting from the lower end of the tunnel and continuing for a distance of 2,700 feet, is a flume resting on a bench cut out of the rock. The bench was cut 36 feet wide; the flume resting on it is 28 feet wide and 7 feet deep, with a grade of 5.28 feet per mile. The flumes crossing Plum creek and Cherry creek are probably the longest in the State, being respectively 918 and 810 feet long. They are 36 feet wide and 7 feet deep. There is a total length of 3,123 lineal feet of flumes on the canals, excluding 216 feet of dams and wasteways. The total cost of construction was nearly $150,000, being greater than that of any other canal in the State. The appropriation of water for the canal is 1,184 cubic feet per second (exceeding the minimum flow of the Connecticut river at White River Junction). On a basis that the duty of water in Colorado is 1.44 cubic feet per second to every eighty acres, this would be sufficient to irrigate over 60,000 acres. But, in consideration of the great loss from seepage, evaporation and other causes in the carriage of such a body of water over such a distance (seventy-one miles and a fifteen-mile branch), it is not likely that the area of cultivation will exceed between 40,000 and 50,000 acres, unless greater economy is observed in the use of the water."

A stop was made to allow opportunity for examining the dam, head-gates and tunnel entrance. The Platte cañon has many features in common with similar Colorado gorges, but the cathedral spires and dome rock, and the attention of narrow passages and charming open glades are characteristic. This series of abrupt changes from glimpses and full views of towering hills and precipices to quiet and secluded scenery was bewildering. And when the ascent of the divide was begun in earnest, and great, dark wooded valleys and chasms yawned below, while a far-off river of many mountains was widening and enlarging with each yard of rise or each big bend traversed, then the wonder and admiration grew apace, and all the air was full of exclamation points. At Kenosha summit the altitude, 10,000 feet, was duly verified by the aneroid battalion. Just beyond this the South Park suddenly burst upon the river like a scene of enchantment. This beautiful elevated valley, perhaps twenty by thirty miles, with its even bottom and rim of mountains towering from 2,000 to 4,500 feet above its center, contains the sources of the South Platte river. It is like an immense saucer with jagged edges, and we had just burst through one of the biggest notches. Dropping down 500 feet, a ride all too short in the enchanted valley brought us to Como, where was a dinner which would have done credit to Denver itself—a high-altitude dinner at a reasonable sea-level price.

Now it might be supposed that after the experience of mankind at the tower of Babel, the engineers might have trembled to scale greater heights; that they would be content with a comfortable line to Leadville running within the South Park, going over the river on the southwest at Trout creek pass, and so tumbling into the valley of the Arkansas; or at least with the digression from Garo's and by the Mosquito pass. But no, they must execute a piece of outrageous and daredevil engineering which has earned for this route the epithet "sky scraper." To get a grip on the town of Breckenbridge and outflank the D. & R. G. road they have emulated Napoleon's passage of the Alps by twice crossing the great continental divide and stealing into Leadville on the north. From Como, by a series of twists and turns into frowning ravines, and around great promontories, and up the most forbidding slopes, a clear ascent of 1,750 feet is made in ten miles and the crest of Breckenridge pass is reached at Boreas, 11,500 feet above the sea. No wonder that the elements attempt to wreak furious vengeance for such audacity, and that long lines of "snow breaks" and snow sheds bear witness to the heavy penalties exacted. A brief stop was improved to gather the wild flowers which were found here in great variety and of beautiful colors. On the right hand and left rose the snow streaked peaks 2000 feet and more, a picture of desolation. Having successfully passed through this second maximum state without being reduced to zero, in spite of mathematical dicta, a rapid descent of 2,000 feet was made in twelve miles, along the edges of yawning ravines, and heavily wooded gorges, around sharp curves on steep slopes at dizzy heights, with enlargingviews of the valley of the Blue, opening beyond, until the train slid into Breckenridge, a busy mining center on the Pacific slope. Here a train of "burros" laden with bags of ore, suggested vividly the pictures of mountain travel in Mexico and the Andes. Again the party was in a minimum state of altitude at 9,550 feet. By an astonishing series of twists and turns around the bases of sharp spurs and main peaks which rose sheer from the roadbed to heights of 1,500 to 3,000 feet, and which in part are nearly bare masses of seamed and

shattered rock, the ascent of Fremont pass was begun. At Climax a maximum was reached for the third time that day, of the value 11,325, and then, once more on the Atlantic slope, a drop of 1,100, on an incline fourteen miles long, landed a scenery-surfeited and weary party in the "biggest mining camp in the world."

Leadville after 21 o'clock, judged from the office of a hotel not more than half big enough to accommodate the crowd, is too much like any other place under similar conditions. But then those who were assigned to "outside" and various scattered quarters could verify the "camp" feature of the place. And there were some who could not rest until they were sure as to the existence of the mines, and so made subterranean explorations and invaded smelting works before retiring to a sleepless couch. Doubtless all were finally composed to a sleep which was more or less indeterminate, and if there were any not so fortunate, they could attribute all discomforts to the altitude. The morning sun revealed the beautiful situation of the place. The snow clad mountains on three sides and not far distant, and the valley of the Arkansas showing a glorious vista southwards made a never-to-be-forgotten picture. A white frost on the ground explained the absence of gardens and the uncultivated appearance of house yards. But the regular and wide streets with many pretty house "fronts" (a veneer on a log cabin), and cottages (mostly one-story), two large brick school buildings, handsome churches, and large business houses give evidence of wealth, intelligence and prosperity. However, Leadville does not ask for judgment from critics who made only one survey and that before breakfast. So we forbear.

Our hosts had not planned a *visit* to the city but only a morning call; here the convention being "in the hands of its friend," boarded the train provided by the receiver of the D. & R. G. Railway Co., at 8 A. M., prepared for another picnic day. The headwaters of the Arkansas, and the city of Leadville, lie in a right angle where the great continental divide, having curved round to the westward, with Mt. Lincoln, as a p. t. and trended thus a few miles, makes a sharp corner and then bears off southward. Hence the morning ride of sixty miles down the Arkansas to Salida affords a constant panorama. On the right are the lofty summits of the Saguache range, a part of the very crest of the continent, rising to heights of from 4,000 feet at Leadville to 7,000 feet at Salida above the river. To the eastward on the left is the Park range, beyond whose summits we can see in fancy the vision of the South Park. Between the two stretches the broad valley of the Arkansas, itself a magnificent park, from ten to fifteen miles wide. As the railroad first lets itself down the higher terraces, traverses the gulches, and then takes the grade of the river itself along its banks, attention is successively drawn to Mts. Massive, Elbert, Harvard, Yale, Princeton, Shawano and Ouray, those summits of the continent on the west side, all of which exceed 14,000 feet in height above the sea.

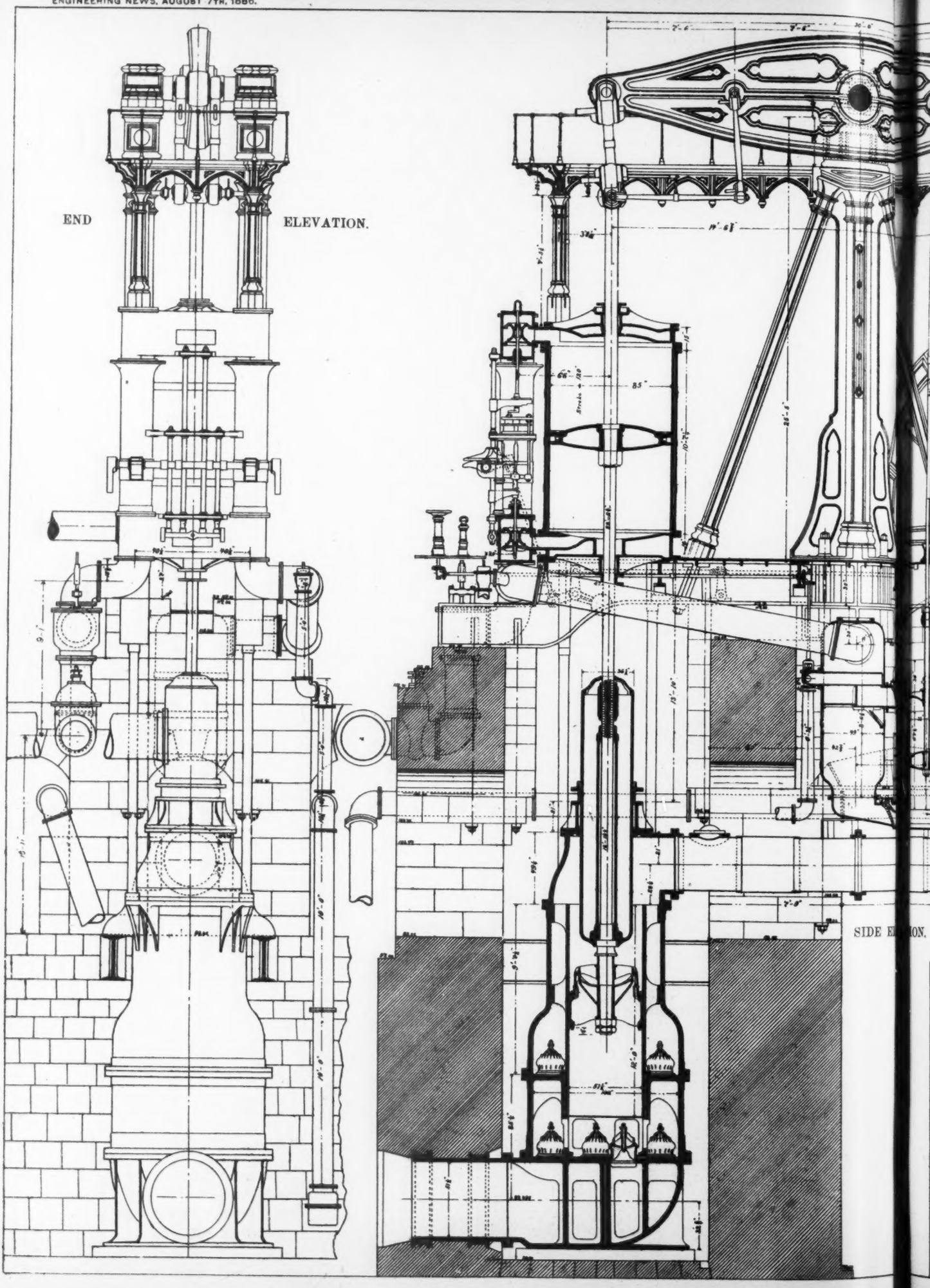
At Salida the party became two. Those who did not care to follow the programme seceded, so as to have the enjoyment of the Royal Gorge in the heat of the day and make full proof of Pueblo as the hottest place in Colorado or anywhere else. The lesser, and in their own opinion, the better half, stuck to the special train, and under command of the company's representative, with two locomotives at the head, started for the Marshall pass and a peep over into the Gunnison country. The approach to the pass over the broad plain in full view of the great Saguache, Sangre de Christo and Park ranges, beside which the White Mountains or Alleghanies would be dwarfed from that level, the rise through the lower defiles to Poncha junction and Mears, and the steady ascent on a uniform grade of four per cent. upon an admirably located road, up steep side valleys and around tremendous spurs, overlooking from dizzy heights wildernesses of timbered gorges and desolate slopes strewn with dry and naked tree-trunks, looking like jack-straws dropped by Titans,—these are some of the features of a ride which cannot be pictured by words. The scenery, while possessing many aspects in common with that seen on the previous day was grander and more far-reaching. At the summit of the pass, 10,850 feet high, bestriding once more the great backbone of North America, the party beheld on the Pacific slope, a billowy sea of mountains, and to the east a still more extended view of the valley of the Arkansas and the enclosing ranges. Right close at hand rose Mount Ouray with snow marked sides, its summit 3,300 feet above the track. Two great snow drifts within a stone's throw provoked the tourists to a vigorous snow-balling contest, a unique experience for the 9th of July. The descent of 3,800 feet in twenty-five miles, returning to Salida, was quickly made.

The afternoon ride down the Arkansas, through the grand cañon and Royal Gorge, cannot be described. It must be a matter of experience. In the first part could be seen, to the south and south eastward, Hunt's peak and Rito Alto and other summits of the Sangre de Christo range coming into view, advancing and receding, as the train proceeded along the winding banks of the stream, which here had free range of a wide valley. But further down, the river seemed to shun the open country and what appeared to be the natural course, and seek a surprising and difficult passage. Gradually the hills closed up, making a succession of gorges and more open ravines, a long prelude to the expected spectacle farther on. The mighty foldings of the rock strata in the great convulsions of the past could be studied on the sides of the hills and the walls of the cañon, in changes of "dip" and "strike," the succession of deposits, the variety of the coloring and other marks which only a geologist knows how to value. But even the most unscientific eye was attracted by the dark bands of black rock, now level and now in great rolls, which divided the great red feldspathic masses into well-marked beds, one above another. By-and-by the chasm became narrower, the walls rose higher and higher until they towered from 1,800 to 2,200 feet almost perpendicularly above the stream, which became scarce twenty yards wide for long distances. This is the famous Royal Gorge. The train stops on the well-known girder bridge suspended from two pairs of iron rafters, which abut against the walls of the cañon, (the design of C. Shaler Smith, a distinguished member of the Society), and the party dis-embarked to try to gain some appreciation of the awful grandeur in which they were, so to speak, buried. Where words were powerless, silence was the only fit tribute to the glories and sublimity of those dreadful heights, gilded by the setting sun. Though one had spent hours in Denver enjoying Jackson's matchless series of views of Colorado scenery, though one had read volumes of descriptions, no complete idea is possible until face to face with the reality. Hence we waste no more words here.

After these exhibitions, emerging into the more open country, all else was tame. Cañon City was soon passed and Pueblo reached in cool of the evening. Then a weary ride while the twenties of the clock were gliding by. Finally a midnight crowd reached Manitou careless of all else but a place to sleep.

After less than six hours of rest and a very "previous" breakfast, without having time even to take a good look at their surroundings, a party of enthusiasts started out to emulate Longfellow's "Excelsior." A cavalcade of forty-five, including four ladies, mounted on mules and horses, with three guides, were headed for Pike's Peak. The animals, be it observed, did not seem enthusiastic; for them there was no novelty in the situation. A mile and a half of good wide road leads to the beginning of the trail in Ute pass at a narrow bridge. Here begins the work. The trail is pitiless. Up along the yielding hill-sides, not to say hill-*slides*, which lie on a slope too uncomfortably near the "angle of repose," with a grade of 20 per cent. crossing and re-crossing the narrow but romantic stream which leaps and tumbles from the ledges above in beautiful cascades, and endeavors to appropriate to itself the whole passage between the threatening heights, up, up, up between and around immense boulders, and overhanging cliffs, the panting animals and their riders struggle skywards. But this first stage, and perhaps the most severe, terminates at the "half-way house," a place of rest in a shady level dell, where the brook invites to needed refreshment, and the party dismounts for a few minutes of recuperation. The name of the place is given to cheer the discouraged ones, evidently, for the guide announces that scarce five miles of the distance are yet traversed, and the aneroid man says that the altitude is 3,000 above the starting. There remains then 6 to 7 miles of trail, and 5,000 ft. of vertical rise yet to be conquered. And the cold bald peak looms up far ahead, apparently not a mile nearer, and not half so inviting as at first. The trail now leads through a spacious wooded valley where the parched and stunted trees give little protection from the sun, which converts the basin into an oven. Rising steadily for a mile or two towards a great spur, the terrible grade of one in four to one in five is again resumed, amidst half naked trees, among boulders, around ridges, into stony ravines, bearing away ever to the right, until the timber line is reached at about 11,500 feet or more. Gradually working around and over a great bare ridge on to the opposite side of the mountain, the peak is now seen rising close to the right hand with the trail stretching upward, sometimes over smooth ground, sometimes through great banks of disintegrated feldspar reduced to the size of peas, and sometimes through immense slopes of broken rock and boulders which make a large part of the surface of the mountain. From one point the trail is seen to disappear around a farther spur apparently about a quarter of a mile distant; but when the advance of the party is seen there, appearing like mere specks this first estimate must be multiplied by four or five. When the goal seems nearly reached and only just around the next bend, a wayside mark reads "one mile" more. But at last the toil of the half-dead animals are ended. The tourists proudly crown the top, which is now found to have considerable length and breadth, although appearing as a true peak from below.

An uninviting summit it is, strewn with masses of jagged red rock (feldspathic granite) which make walking very laborious. The party at once invaded the snug and fortress-like stone houses of the Signal Service. The two observers on duty looked as though they had seen visitors before, but answered various pertinent and impertinent questions, and produced cheerful cups of coffee which were ex-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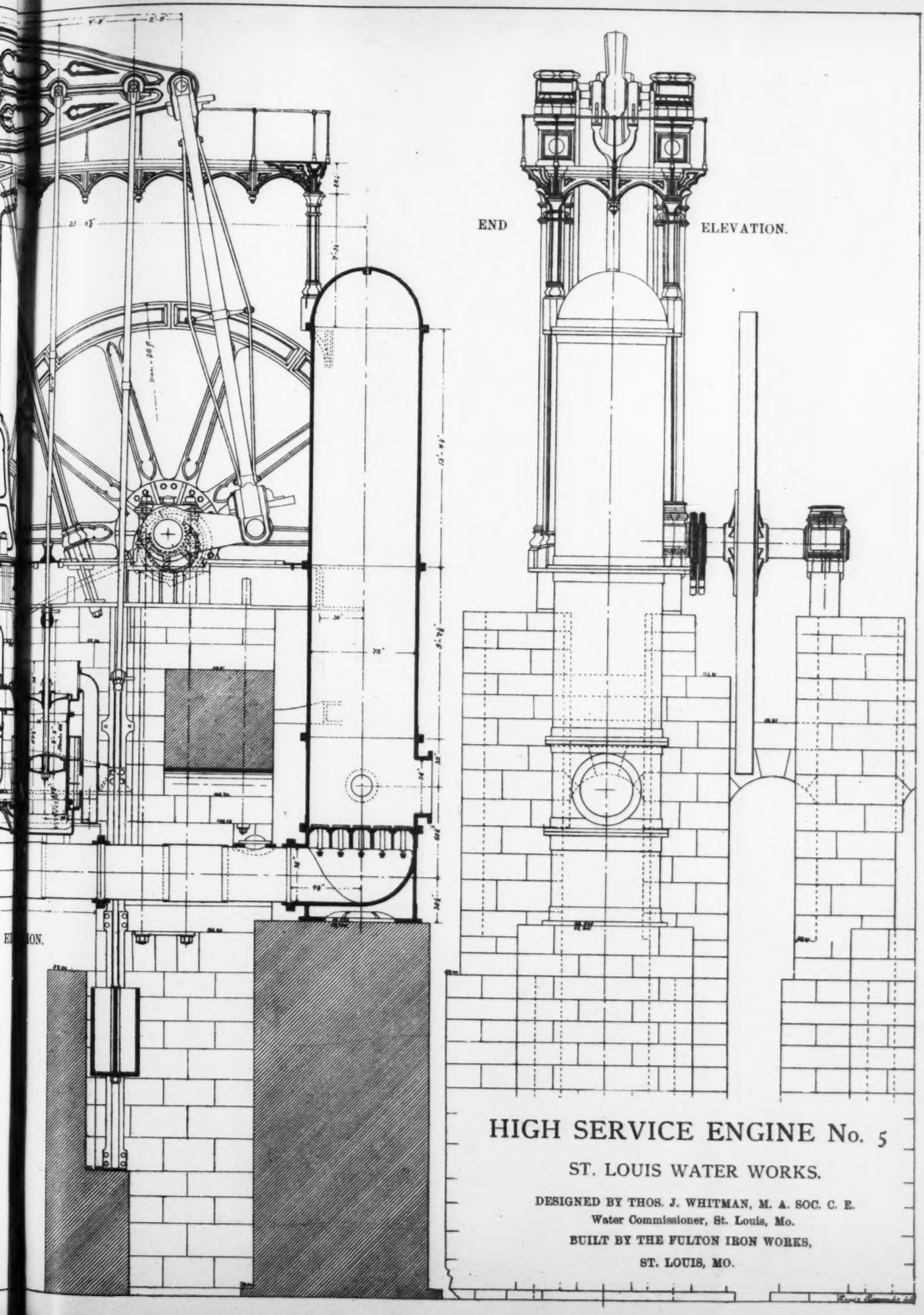


HIGH SERVICE ENGINE No. 5

ST. LOUIS WATER WORKS.

DESIGNED BY THOS. J. WHITMAN, M. A. SOC. C. E.
Water Commissioner, St. Louis, Mo.

BUILT BY THE FULTON IRON WORKS,
ST. LOUIS, MO.

changed for a cheerful consideration. Meanwhile the four-footed animals were gathered about and within a heavy stone building at the end of the trail to discuss the question of oats. The aneroid man was seen with a less confident look trying to adjust a little discrepancy between his indications and the accredited altitude, 14,147 feet. He doubtless questioned the certainty of the last 100 feet, more or less, and was looking after the probable error. As he did not announce any satisfactory result we still have to write 14,147 + x feet. After all that has been said about effects of high altitude it was noticeable that the party seemed to have very little concern about the reduced external pressure. But there was considerable remark about a lack of pressure *within*, and so immediate attention was bestowed upon the contents of sundry paper bags brought from hotels. After these preliminaries, scenery was in order.

To the eastward the prairie, literally unbounded, because the horizon was obscured by the haze. By the usual formula for curvature and refraction, the limit of the horizon on a level prairie, from this altitude, should be about 150 miles. The dark areas of irrigated country were like continents and islands in a sea of silvery green. Colorado Springs with its regular streets was a verdant checker board just outside the foot hills which are grouped about the mountain. Denver, 65 miles to the north, measured on an visual ray, could be distinguished by the smoke of the smelting works. Manitou nestled close under the toes of the mountains. To the south, 103 miles in air line were Spanish peaks; to the north, 106 miles, Long's peak and the Rockies far beyond; between those two extremes, stretching along the west, were the ranges of the great continental divide, at no point nearer than 65 miles, a magnificent array of snow-clap ridges and peaks, standing like a mighty wall made golden and silvery by the unclouded sun. The intervening country was a sea of lesser mountains, naked or half clad by scraggy timber growth, a wilderness and land of desolation. These are but a few memories of a panorama which was impressed on each beholder as an everlasting remembrance.

The descent was not like Mark Twain's descent of Vesuvius, but slow and toilsome like the ascent. Five hours in the saddle either way and an allowance of two hours on top make arithmetically 12 hours; experimentally about 24, judged by the flesh and not by the mind.

The other lesser attractions of Manitou, the springs, the baths, the caverns, the Garden of the God's with its wondrous array of curious and stupendous rock-masses, the drives, the hotels, etc., were all enjoyed as much as possible within the limited time of less than 48 hours, Sunday excluded. If Saratoga can draw its thousands then Manitou and Colorado Springs should have tens of thousands. Here the attractions are real and grand and natural, and suited to all conditions and dispositions,—to invalids needing quiet and repose, and to venturesome seekers after active sport and rough adventure.

But little need be said of the homeward journey. The afternoon and evening ride from Colorado Springs to Denver afforded parting views of the grand old mountains under a cloudy sky. The last look at Pike's peak from Colorado Springs was a vision of the majestic head against a dark background of threatening clouds, rising as if to pierce the sky, copper-hued and silvered by the partially obscured sunlight, and standing in glory among and above the black mountains which lay clustered all about it. Palmer lake, a beautiful sheet of water, artificially made on the divide between the slopes of the Arkansas and the Platte, with its graceful jet of water streaming up in the center, attracts attention in the twilight. Its altitude is 7,236 feet. From Denver to Kansas city, via. the Kansas Pacific Railway in 22 hours. Leaving Kansas city about 21½ o'clock Monday evening, Quincy was reached next morning and Chicago soon after 13 o'clock. Here again a change of route gave something of a chance to see another part of the country. Passing through Central Michigan, Detroit and Southern Canada, Wednesday morning found the "special" at Welland, in time to see the big canal. The magnificent views of Niagara Falls which the Michigan Central Railway affords, both above the "horseshoe" and from the cantilever bridge, were duly enjoyed and all agreed that there is nothing like it, even in Colorado. Niagara transferred to a place among the towering mountains of Colorado would certainly lose some of its grandeur and beauty, but the people of that State would be very glad to have the water. After a stop at Buffalo just long enough to get a fair start on the home stretch, the run to New York was rapidly made and the "special" with its occupants disbanded about 11 P.M.

Thus ended a convention second to no previous one in interest and value. The reflections and the corollaries and *morals* to be extended must be various as the participants: so each must be left to make the summing-up for himself and his friends. R. F.

Specifications of High Service Pumping Engine No. 5, and Boilers, St. Louis, Mo. Water Works.

(*With Illustration.*)

GENERAL AND DETAIL DRAWINGS.

There are thirty-three sheets of general and detail drawings which accompany these specifications; and the party of the second part will furnish to the party of the first part fifteen additional sheets, showing fuller details of the valve and cut-off motion, of the boilers and steam pipes, of the casings for the steam cylinders, steam chests, and air chamber, of the drip pans for the various journals, etc., which thirty-three drawings together with the fifteen additional ones here spoken of shall constitute a part of this contract and specifications.

MATERIALS.

All classes of materials, of whatever kind, used throughout the work called for by this contract and specifications shall be of the best.

Cast Iron.—The steam cylinder, the main pump barrel, the pump plunger, the counterbalance guides, and the toes and lifters of valve gear, to be made of a hard and close grained iron.

The iron used for the beam, steam cylinder, cylinder head and bottom, upper ring, jacket, steam piston, follower and junk ring, pillow blocks and caps, counterbalance guides, and for the twelve pieces of main pump castings, to be of the very best quality, and to possess a tensile strength, as exhibited in the testing machine, of not less than 25,000 pounds per square inch.

The iron used for the bed plates, girders, columns from bed plates to pump, centre and diagonal columns, steam and exhaust chests, valves and bonnets, side-pipes, fly-wheel and hub, eccentrics and straps, gallery frame and columns, air chamber, air pump and piston, condenser and channel ways, all iron valve bodies and bonnets, pipe elbows, tees, saddles and flanges, all manhole covers, other than those for main pump, to be of superior quality and to possess a tensile strength, as exhibited in the testing machine, of not less than 20,000 pounds per square inch.

The iron used for all other castings throughout the machine and appurtenances to be of proper quality and to possess a tensile strength, as exhibited in the testing machine, of not less than 16,000 pounds per square inch.

Any casting in which the tensile strength of the iron as exhibited in the testing machine falls more than five per cent. below the strength specified for the class of work to which the casting belongs shall be rejected.

Wrought-Iron.—All machine forging shall be made of the *best quality* of charcoal hammered scrap. For the main connecting rod, links, shaft, crank, beam center, crosshead, piston and pump rods, the scrap to be faggotted to form the various parts.

The plate iron in the 36-inch connection between the pump and air chamber, the shell, steam dome and ash pan of the boilers, and all of the rivetted wrought-iron steam and exhaust pipes, be of the best quality C.H.No. 1 iron, stamped according to the U. S. requirements, with two samples attached to each plate.

All wrought-iron used for the diagonal, foundation, pillow block and other large bolts, and for all joint bolts, to be of the best quality of refined iron.

Each large bolt must be formed from a continuous bar of iron: no welded joint will be allowed in any bolt used in the machine.

The bands on hubs of main beam and around the openings in the main pump castings to be of the best quality of charcoal hammered scrap, *perfectly welded* and shrunk to place.

All braces, crow-feet, pins and stay bolts, for boilers to be of charcoal refined iron, free from flaws and imperfect welds.

All of the wrought-iron referred to above to have a tensile strength as exhibited in the testing machine of not less than 50,000 pounds per square inch of section, an elastic limit of not less than 26,000 pounds per square inch, a ductility of 16 per cent. in twelve diameters, and not less than 25 per cent. reduction of area at breaking point, and to stand the following tests when applied to specimens of an inch area and 15 inches length of smallest section, viz.: must bend cold through 180 degrees around a cylinder having a diameter equal to two-thirds the length of the shortest side, without sign of fracture.

Steel.—The following parts shall be made of steel, equal in quality to the best machinery steel manufactured by the "Otis Steel Co.," Cleveland, Ohio, viz.: All of the beam pins (with the exception of the main center), the crank pin, front rock shafts, steam and exhaust valve spindles, steam piston follower bolts, all of the journal pins, all of the keys, including those in all of the connecting rods, and the set screws throughout the machine. The tensile strength, as exhibited in the testing machine, to be not less than 70,000 pounds per square inch of section, with a ductility of at least 25 per cent. in twelve diameters.

Specimens 1 square inch in area of section shall bend cold through 140 degrees around a cylinder, the diameter of which is four times the length of the shortest side of the test piece.

The following parts of the boiler to be of the best quality of mild steel, of a tensile strength, as exhibited in the testing machine, of not less than 60,000, or more than 65,000 pounds, per square inch of section, an elastic limit of not less than 40,000 pounds, a ductility of 25 per cent. in twelve diameters, and not less than 15 per cent. reduction of area at breaking point, viz.: the heads, furnace, flue connections and flue sheets, and all flanged pieces, except the dome.

All plate steel used in the boilers to stand a test of bending cold upon itself after being heated to a cherry red heat, by daylight, and plunged into water of temperature of 70° F. without showing fracture; specimens so tested to be not less than 2 inches wide, and may be taken either lengthwise or crosswise of the plate. All plates must be stamped in accordance with the United States requirements. Two samples shall be attached to each plate.

Composition.—All of the composition metal, excepting the phosphor bronze and Muntz metal, used in the construction of this machine, shall consist of the best quality, *new material only*, of pure ingot copper and tin, and spelter; and when cast shall consist of the following proportions, by weight, as determined by an analysis of the turnings or chippings, to wit: Copper, 85 parts; tin, 10 parts; spelter, 5 parts.

The following pieces and details to be made entirely of composition, viz.: The main pump bucket, valve and followers; the main pump valves and valve seats; the follower of air pump piston; the foot and delivery valve seats and guards of air pump; all packing glands (except the one on main pump plunger), and all connecting rod boxes, journal boxes, all nuts used on the Muntz metal spindles, studs and bolts, and all bushings, valves, valve seats, nuts, etc., required, shall be furnished of composition, even if not mentioned in the specifications or shown on the drawings, and shall be of the best workmanship and finish. No cast composition bolts or screws shall be used.

Phosphor Bronze.—The lining of the air pump barrel and the casing of the air pump rod to be made of phosphor bronze.

Muntz Metal.—Rolled Muntz metal, well annealed, shall be used for the spindles of check valves in air chamber; for the spindles of all stop, throttle and injection valves; for all gland studs; for the follower studs of main pump bucket and air pump piston; for all holdingdown studs of main pump valves, and for all studs and bolts of the air pump valve seats and guards.

Copper.—The expansion plates in the side pipes to be of pure copper and to be faced true and recessed as shown in drawing. The shower nozzle in the exhaust pipe, the ring under the edge of the main pump barrel, and the rings for the joint between the steam cylinder and its jacket, to be of pure copper.

Rubber.—The foot, discharge and air escape valves, for the air pump, the cushion rings for the bucket, pump and check valves, and the rubber rings for the air chamber check valves to be of the best quality of pure valve rubber.

All sheet rubber used shall be of the best quality.

Lumber.—All pattern lumber used to be of the best quality of soft white pine, free from sap and thoroughly seasoned.

The lagging to be of the best quality of walnut, clear and free from sap and thoroughly seasoned.

Preserved sound oak to be used under the bottom pump casting.

Specimens for Testing.—Specimen rods, of such dimensions as may be directed by the inspector, of the cast-iron, composition and phosphor bronze used, shall be prepared when required.

These specimen rods to be poured either before or after the casting has been made, as may be directed.

Samples, of such dimensions as may be directed by the inspector, of the iron used for forgings, rivets, braces, etc., and of the Muntz metal used shall be furnished when required.

DESCRIPTION, DIMENSIONS, ETC.

The general and detail drawings define the design, form and dimensions, of the various parts of the machinery and appurtenances; some of the details, however, which are not fully shown, are described below.

Pump Foundation.—The main pump to rest on a course of oak timber, 8 inches thick. The timber to be well fitted and forced into place and to be dressed to a circle of 65 inches radius. The upper edge of the platform to be chamfered.

Valve Motion.—The valve motion, with Sickle's cut-off, detail drawings of which will be furnished by the party of the second part, is to be similar in design and workmanship to that in use on High Service Engine No. 1.

Steam Piston Packing.—"Babbit and Harris" steam piston packing to be used. The patent royalty for the steam packing will be paid by the party of the second part, in addition to the contract price stated in section X.

Pipe for Steam Jacket.—The steam jacket to be supplied with a 1-inch steam pipe, taken from the 30-inch steam pipe and entering the jacket at the rear upper side, and a 1-inch waste pipe leading from the rear bottom side of jacket into one of the boilers.

Lubricator.—A 4-inch "Hydrostatic Lubricator" with glass gauge, solid body, nickel plated, of "Nathan and Dreyfus'" make, to be attached to the front side of the lower steam-chest.

Indicator Attachment.—The two ports of the steam cylinder to be connected by 1-inch brass pipe with two ground joint unions, two angle valves, and one three-way cock for indicator attachment.

Counter and Gauges.—One revolution counter, one vacuum gauge; one steam gauge for engine-room and five for boilers, the steam gauges graduated from 0 to 60 pounds; and two water-pressure gauges, graduated in pounds and feet, from 0 to 120 pounds; to be furnished similar in material and workmanship to the gauges and counter of H. S. Engine No. 4 and boilers. The counter and the engine-room gauges to be nickel-plated. The supports for the engine-room steam and vacuum gauges, and for the counter, to be of polished brass.

Covering for Cylinder and Steam Pipes.—The steam jacket, steam chests and side pipes, and all of the steam pipes, with valves, elbows, etc., after being thoroughly cleaned and painted, are to be covered with a non-conducting material composed as follows: First, a coat of No. 1 asbestos paste, ¼ inch thick, applied on the hot iron; second, this to be covered with a coat of No. 2 asbestos paste, ¾ inch thick, securely wired; third, another coat of No. 2 asbestos paste, ¾ inch thick, finished smooth on the outside. When the coatings are dry, in the case of the steam jacket, steam chests and side pipes, the remaining space inside of the walnut casing, about 2 inches, is to be filled with clean and thoroughly picked hair, closely packed; and in the case of the steam pipes, valves, etc., two layers, ½ inch each, of the best quality of Lowell Mills hair felting are to be laid so as to break joints, and securely wound with twine, the hair felt to be covered with a layer of thick paper, and the whole with 8 ounce duck canvas, securely and smoothly sewed on, and thoroughly coated with two coats of paint of best quality. The cylinder head and bottom to be covered with a coating of asbestos paste not less than 2 inches thick.

Covering for Boilers.—The upper surface of boiler shell, not covered with brick work, and the steam drum, to be covered with a layer of mineral wool 3 inches thick, which is to be covered with a cold rolled No. 20 sheet iron casing, securely fastened in place.

Walnut Casing.—The steam jacket, steam chests, side pipes, and the air chamber are to be encased with walnut lagging, similar to that of H. S. Engine No. 1, properly fastened, leaving a space of about 3 inches between the wood and metal.

Brass Bands.—The steam cylinder and air chamber casings to be surrounded each by five finished brass bands, 4¼ inches wide by ⅜ inches thick; the chests and side pipes with two bands each, 2 inches wide and ⅜ inch thick. Each band to be composed of one continuous piece and to be held in place by solid oval-headed brass screws.

Cast-Iron Mouldings and Covers.—Cast iron mouldings to be furnished for top and bottom of the casings of the air chamber, steam cylinder, chests and side pipes.

A false cast-iron dome to be furnished for the air chamber. A false, finished cover in two pieces, of cast-iron, for the steam cylinder, provided with a covered circular manhole, 17 inches diameter.

Ornamental cast-iron casings to be furnished for the brackets for the gallery columns, both on the steam cylinder and air chamber.

Wall Plates and Washers.—The wall plates for the main shaft pillow block holding-down bolts will be furnished by the party of the second part. All other wall-plates and washers to be furnished by the party of the first part.

Injection Pipe.—In addition to the two 6-inch injection pipes from the wet well, a 4-inch injection pipe is to be brought from the pump main to, and connected with the condenser.

Small Stop Valves.—All stop valves used, not exceeding 3 inches, including the four 3-inch valves for drain pipes of pump, to be entirely of brass, except the hand-wheel, and to be gate valves similar to the "Coffin" valves in use on H. S. Engine No. 1. There will be required of the same make, but having cast-iron bodies with brass trimmings, and stationary spindles, four 4-inch flanged valves for injection and feed pipes.

Steel Keys for Beam Centers and Main Crank Shaft.—Fly wheel, 2 keys, 3 inches by 2½ inches.
Main center, 2 keys, 2½ inches by 2 inches.
End centers, 2 keys, 2 inches by 1½ inches.
Counterbalance center, 1 key, 1¾ inches by 1 inch.
Air pump center, 1 key, 1¼ inches by ⅞ inch.
Parallel motion center, 1 key, 1½ inches by ⅞ inch.
The taper of the keys to be about $\frac{1}{16}$ inch to the foot.
All key-ways to be cut true, and the keys to be perfectly fitted.

Packing and Gaskets.—For permanent steam joints use a putty of strictly pure white and red lead, to be made and applied in accordance with detail directions.

For removable steam joints, such as bonnets, hand-holes, etc., use a hard rubber cloth inserted gasket, coated with plumbago on one side.

For manholes and handholes of boilers, use a lead gasket.

For cold water flanged joints use a ¼ pure gum rubber gasket of full width of flange, coated with tallow on one side.

For pump bucket packing, use a 1 inch square cloth inserted rubber packing.

Stairway.—An iron stairway with platforms to be erected between Engines Nos. 4 and 5, with all necessary stanchions and handrail; the whole to be properly connected with the present gallery of Engine No. 4. The party of the second part will furnish the iron stairway and the stanchions for same. All other stanchions, and all of the handrail and brass guides for the stairway and gallery, to be furnished by the party of the first part.

Handrail and Stanchions.—The gallery and staircase handrails to be of seamless brass tubing, 1¼ inches diameter, passing through finished composition guides, supported by finished wrought iron stanchions.

Of the forty-one brass guides upon the gallery stanchions, eleven are to be short, and thirty long. Of the seven for cylinder gallery, three are to be short and four long; and all of the nineteen for the stairway to be long.

Drip-Pans.—Drip-pans made from No. 15 (standard wire gauge) brass plate, and similar in construction and finish to the drip-pans upon H. S. Engine, No. 4, to be furnished and attached to the crank end of main connecting rod, to the lower ends of the front links, to the sides of crank shaft and beam pillow blocks; and from No. 16, brass plate, for all of the smaller journals in the engine room.

All of the journals below the engine room floor to be provided with No. 16 (standard wire gauge) galvanized iron drip-pans.

One Length of 36-Inch Pipe.—The length of 36 inch cast-iron pipe referred to in section L, has an internal diameter of 36 inches, is 2 inches thick, and has a flange 48 inches diameter, and 3 inches thick at each end. The flange which connects with the 36-inch valve, is 2½ feet lower than the other flange, and 12 feet 8¼ inches distanced horizontally.

Extra Castings.—An extra floating cover, and an extra lower channel way for air pump, to be furnished, fitted up complete according to templets and gauges furnished by the party of the second part.

Boilers.—The first party to furnish, deliver and set up on the foundations, five cylindrical boilers of the "return drop flue" variety, complete and alike in every particular; to furnish the steam, and all other pipes, valves, gauges, cocks, stands, arches, grate bars, flooring in front, girders front and rear, frames and covers for ash ducts, and two scuttle covers; to make all necessary connections, and apply all fixtures, so as to complete the boilers to conform to the setting, fitting and finish (except wear from use) on battery of boilers now in service with High Service Engine No. 1.

The dampers, and damper frames, and the floor plates in rear of boilers, will be furnished by the party of the second part; the party of the first part must make all changes in floor plates, and do all fitting required to complete the work in place. The holes for the blow-off pipes in the rear floor plates, are not in the proper places, and must therefore be neatly patched and new ones cut in the plates, and supplied with the proper shaped hubs.

The connection of steam dome with boiler is to be with one central circular hole, 14 inches in diameter, and two side holes 3 inches in diameter.

The joint between steam dome and shell, and the joints around the opening in the bottom of boiler, to be double riveted (staggered.) The vertical joints of the boilers to be single riveted lap, and the horizontal joints double chain riveted lap.

The rivets for boilers are to be ¾ inch diameter, and of sufficient length to give ample metal for heads; rivets to be placed not more than 2 inches from center to center.

Steam Pipes.—A 30-inch wrought-iron, ⅜-inch plate, steam pipe, with cast-iron flanges (19 feet long, including flanges), is required to connect the engine with the present steam pipe. The 21 inch wrought-iron pipe of ⅜ inch plate is required of length as shown in drawing of plan of boilers. This pipe connects with a 21-inch steam valve already in position.

Test of Boilers.—Each of the boilers to be subjected to a cold-water pressure of fifty (50) pounds per square inch, and any defects or leaks to be thoroughly corrected.

Boiler Heads.—The heads of the boilers to be constructed from a single ⅝-inch sheet, no joint being allowed in either the front or back head; the heads must be true and even, and the doors and plates accurately fitted.

Manholes for Boilers.—The back head of each boiler to be provided with two ellipitical manholes, a wrought-iron ring ½ inch by 1½ inch, being riveted around the inside of the manhole with countersunk rivets, and made true and smooth on the inside; and to be also provided with a circular opening, 15 inches diameter, covered by a cast-iron door lined with fire brick.

Braces and Stay Bolts.—The boiler heads, the top of furnace, and the front and back connections, to be braced to shell of boiler by forked braces and crow feet of wrought-iron; braces to be 1 inch diameter, and placed 7 inches from center to center.

Water spaces between furnace and shell, between furnace and front head, between ash-pan and front connection, between back connection and head, and all other water spaces to be braced by socket stay-bolts, ⅝ inch diameter, and 7 inches from center to center.

All joints, rivets and stay-bolts to be made tight; all braces made to draw even, and all pins properly fitted and securely fastened in place.

Pipe Connections.—A 4-inch wrought iron pipe to connect the present boiler feed pump with the 4-inch feed-pipe shown on drawing. The blow-off pipe to be of wrought-iron 3 inches diameter from each boiler, and connected with a 4-inch pipe laid under the floor in rear of the boilers, which 4-inch pipe is to have five sets of union flanges, is to extend 5 feet beyond the boiler-room wall and to have a fall of ¾ inch for each 7½ feet.

The two 5-inch escape pipes from the safety valves to be carried 6 feet above the roof, and to be surmounted by an ornamental bell cap.

A 2½ inch wrought-iron pipe to be connected with the present well pump and to run to the bottom of the counterbalance pit, and to be supplied with a stop valve, and foot-valve.

A 1-inch wrought-iron pipe to connect the upper section of the air chamber with the present air-compressors.

Supporting Columns.—A light, adjustable, cast-iron column to be placed for support under each of the five 8-inch steam valves, and a light cast-iron column under each of the two 5-inch escape pipes.

Furnace and Ash Pan Doors.—The furnace doors to be of cast-iron, to contain an air register, and to be lined with a perforated cast-iron plate. The ash pan doors to be made of ⅛-inch boiler iron, and to contain an air register of cast-iron.

WORKMANSHIP.

The workmanship and finish throughout the engine, pump, boilers and appurtenances, both in construction and erection, shall, in every respect and particular, down to the smallest detail, be thorough and of the very best; and any piece or part of the machinery

however perfect it may be in other respects, if defective in regard to workmanship, shall be rejected.

Planing and Facing.—Top and bottom of bed-plates, main and air pump girders, and the bottoms of the lower castings of main pump and air chamber are to be planed.

The diaphragm plates of main pump are to be planed true and smooth for their entire upper surfaces.

The bearings of all nuts on pillow blocks, and of all holding-down bolts on bed-plates, girders, skew-backs, wall-plates and washers to be truly faced.

All of the flanges of main pump, steam cylinder, condensing apparatus and air pump to be truly faced (the back side of the flange to be counterbored for seat of nut or bolthead, parallel to the face of flange), and, with the exception of flanges of rectangular openings, to have their edges turned to the proper diameters.

All flanges on wrought-iron steam, exhaust or water pipe, to be faced true, and the bolt holes drilled before riveting.

All the fitting edges of the gallery and of the engine and boiler room floor plates to be planed, allowance for planing being made in the castings.

The steam chest covers to be turned on the outside, but not polished, except where exposed to view.

Turning and Boring.—The top of the middle section of the pump to be bored true to receive the lower end of the pump barrel, and the barrel to be turned to a perfect fit.

The steam cylinder, main pump barrel and air pump barrel to be bored vertically, and the pump plunger turned perfectly parallel, *true* and *smooth*. The upper inside surface of the plunger to be bored for a distance of 3 inches, proper allowance being made in casting the plunger.

The boiler stands to be bored out, and planed on the bottom.

The outer circumference of the fly-wheel and the two 2-inch edges of the sides of the rim to be turned true and smooth, and the corners to be rounded to a radius of one-half inch. The turning to be done either at the shop or after erection in place.

Joint between Steam Cylinder and Jacket.—Great care shall be taken to have the surfaces of cast iron which form the lower joint between the steam cylinder and its jacket turned perfectly true, smooth and parallel, to a slightly forcing fit.

The grooves in the jackets, which receive the copper rings, 1 inch by ¼-inch, are to be bored out, the copper to be poined in, and turned down as nearly flush with the iron as is possible without allowing the tools to touch the iron. The cylinder and jacket are then to be forced together.

Lining of Air-pump, Cylinder and Rod.—The bronze lining of the air-pump to be cast in not more than three rings, to be properly turned and forced and fastened into place, and bored true and smooth to the proper diameter.

The air-pump rod is to be turned, and the bronze casing cast in not more than four sections bored and forced on, and turned true and smooth.

Bright Finish.—All of the front work, the connecting rods, shafts and pins, the stands and hand wheels in engine room, the casings for the expansion joints, the false covers for the steam cylinder and chests, and the circular bonnets for steam chests are to be bright-finished.

The ends of all pillow block bolts, exposed in engine room, together with their nuts, keeper rings and set screws, are to be bright-finished.

Case Hardening.—All bright-finished nuts of the front work and valve gear, to be case-hardened.

Draw File Finish.—All connecting rods, the rods of parallel motion, and valve gear, and the spindles of steam and exhaust valves to be draw-file finished.

Pump Valves and Pump Bucket.—The pump valves and valve seats and the pump bucket, with its valve, to be ground together by turning, scraping and grinding, so that they will be perfectly tight under a pressure of 100 pounds per square inch.

Fly-Wheel.—Each segment of fly-wheel has a projection 8 inches diameter by ¾-inch high on one end, which fits into a corresponding depression in the adjoining segment. The projection is to be turned slightly tapering and forced into the depression of the adjoining segment.

The flanges of the hub of fly-wheel to be fitted true and shrunk or forced on to the shaft.

Beam Pins.—All of the beam pins to be properly fitted and forced into place.

Centers.—All lathe work must be cut to length and properly centered before turning, and all centers shall be of appropriate size, and must be preserved and remain in the work after completion.

Air-pump Floating Cover.—The wood fitted into the groove of the floating cover to be white pine pattern lumber, cut into lengths of about 18 inches and projecting ¾ inch below the iron.

Castings.—The middle and lower section of main pump, and the lower section of air chamber containing the diaphragm plates, are to be cast with the plates down to insure sound metal.

All castings to be full as to the dimensions required, to be true and even, and without blow-holes, or defects of any kind. Any defective castings, when discovered, shall be rejected. Great care must also be taken that all cores are set true and securely anchored, to insure even thickness of metal; neglect of this requirement will cause castings to be rejected

Fillets.—All corners at angles in castings to be provided with *large* fillets; no small brackets will be allowed.

Bolts.—All bolts used throughout the construction of the engine and pump (except bolts ¾ inch diameter or under, used in pipe flanges), shall be truly centered and squared, the threads cut in a lathe, and shall have hexagon heads and nuts, faced on both sides.

All bolts ¾ inch diameter, or under, used in pipe flanges, or around the boiler room flooring, may be machine cut bolts with square heads, finished points, and hexagon nuts faced on the inside.

Bolt Holes.—All of the bolt holes in the flanges for the joints between the ends of the bed plates, between the connecting pieces and the bed plates, between the bed plates and the cylinder bottom, and also in the flanges for the joints between the steam cylinder, jacket and ring (which latter joints are to be permanently made in the shop) are to be reamed and the bolts thereto be turned to a proper driving fit and plainly marked with figures indicating their respective places.

All flanges to be cast solid and the holes to be drilled, not cored out.

The boiler door hinges also to be cast solid and the holes drilled and reamed, and the pins turned to fit.

Grooves in Brass Boxes.—The upper brass of all journals to have a straight longitudinal groove cut in the upper inside surface, the groove extending not quite to the ends of the brass, and the lower brass to have two longitudinal gutters, one on each upper inside edge, the gutter extending not quite to the ends of the brass.

In addition to the above, the lower brass of the front links and the fork end of the connecting rod to have four grooves, which start at the end of the gutters above mentioned and lead down towards the center of the brass.

Flanging.—Great care must be taken not to crack or injure sheets in flanging. No cracked or ragged flange will be accepted.

Riveting and Calking.—All rivet holes to be accurately drilled or punched, from surfaces in contact to a templet, and of such size that the rivets properly fill the holes. The sheets, if punched, to be punched with a center or nipple punch.

In adjusting the rivet holes the drift pin must be sparingly used. If the rivet holes fail to meet properly, they are to be reamed out larger, and a correspondingly larger rivet is to be used.

The quality of rivets used to be equal to Burden's make.

All riveting must be thorough, and the rivet heads finished uniform and smooth. All calking edges of riveted sheets to be planed or chipped smooth with suitable bevel before being bent.

At junctions where three plates overlap, the edge of one of the plates is to be well scarfed down while hot.

All joints throughout the boilers, and wrought-iron steam and water pipes, to be thoroughly calked with a round nose calking tool. The joints on the 36-inch connecting pipe to be calked both inside and out, and all joints on steam and exhaust pipes to be calked on the outside. No split calking will be allowed.

Fastening of Floor Plates.—The gallery floor plates are to be fastened to the gallery brackets and beams by means of ⅜-inch screws with V-shaped countersunk heads.

The engine-room floor plates to be fastened with ⅝-inch through bolts with V-shaped countersunk heads 1 inch diameter.

Rust Joint.—A rust joint, of cast-iron borings, to be made and driven under the bed-plates, girders and bottom of air chamber, in such manner as may be directed.

Painting.—All castings must be properly trimmed and smoothed, and thoroughly cleaned, before being painted.

All unfinished iron work below the engine room floor, and that above the floor intended to be encased, to be thoroughly cleaned, prepared, and painted with three coats of No. 1 paraffine varnish, the first coat to be put on at the shop, the metal being moderately heated before the varnish is applied; this to include the unfinished parts of the foundation and all other bolts, all studs and nuts, and all pipes, castings and other parts of the work. The painting is to be done previous to the putting together of the parts.

All unfinished iron work above the engine room floor, not intended to be encased, to be painted with one coat of pure lead paint before leaving the shop, and, after erection, to have three coats of pure lead paint applied, striped and varnished to correspond with H. S. engine No. 1.

The materials used in the construction of the boilers and steam pipes must be protected from rust until they are finished, then thoroughly cleaned and covered with two coats of No. 1 paraffine varnish before being delivered at the Water-Works, and all accessible parts to have an additional coat, after erection, before the non-conducting material is applied.

Patterns.—All patterns to be made in a durable manner, well varnished with shellac varnish, core boxes blacked, and to be delivered to the party of the second part in good condition.

Templets and Gauges.—A templet for the bolt holes in the flanges of the main pump valve seats will be furnished to the first party by the party of the second part.

The flanges of the 30-inch steam pipe, and the flange of the 21-inch elbow which connects with the 21-inch valve now in the boiler-room, are to be marked and drilled in place.

The holes in the flange of the bottom pump casting, which connects with the inlet pipe, to corresponds with the holes in the flange of the inlet pipe as furnished in place by the party of the second part.

Pipe Left Unriveted.—Some one flange of every wrought-iron pipe connection to be left unriveted, so as to allow of adjustment to the exact length.

Erection in Shop.—The party of the first part to erect in the shop, the bed-plates with the center and diagonal columns, and also the steam chests with side pipes and front work complete.

NEWS OF THE WEEK.

Contracting.

Pumping Engine.—Bids were opened at the City Engineers' Office, Milwaukee, Wis., on July 27th for a 6,000,000-gallon high service pumping engine and two steel boilers. The bids were as follows:

H. R. Worthington, New York	$39 500
Gordon & Maxwell Co., Hamilton, O	26,000
E. P. Allis & Co, Milwaukee, (Plan A)	24,250
" " " (Plan B)	23.750
" " " (Plan C)	20,250

The contract was awarded to E. P. Allis & Co., on Plan A, which is for a three cylinder, triple expansion pumping engine, guaranteeing 115,000,000 duty per 100 pounds of coal.

Sewers.—The following proposals for laying sewers were received by the Sewer Department, New London, Conn., W. H. Richards, engineer. The bidders were, P. F. Brennan, Waterbury, Conn.; John A. Gill, Boston, Mass.; and M. S. Austin, New Britain, Conn., and the detail prices are given in this order: Brick sewer, 20 by 20 inches, $3.25, 3.50, $5, per foot; 18 by 20 inches, $3.25, $3.15, $4.75. Pipe sewers, 24-inch, $2.25, $2.50, $3 per foot; 20-inch, 60 cents, 60 cents, $2; 18-inch, 50 cents, 75 cents, $1.75; 12-inch, $1.15, 90 cents, $1.25. Setting stand pipe, $1.25, $1, $10 each. Manholes, all $3 per vertical foot. Rock excavation, all $4 per cubic yard. Sheeting and bracing left in, $15, $20, $20, per M. Foundation plank, $25, $30, $25 per M. The contract was awarded to P. F. Brennan; the amount of the contract is about $19,000.

Brooklyn and Brighton Viaduct—The bids for the construction of the viaduct to connect the villages of Brooklyn and Brighton were opened July 30 by the Commissioners of Cuyahoga county, O. The structure will be about 1,500 feet long and is to be completed by December. The contracts were awarded as follows:

Substructure, including embankment, excavation in foundation, concrete, and masonry, West & Sweeney	$ 7,939.82
Iron superstructure, Buckeye Iron Bridge Works	24,813.40
Timber superstructure, H. B. Carpenter	2,1[illegible].35
Hand rail, King Iron Bridge and Manufacturing Company	1,882.50
Total	$36,684.07

Tests of Brick.—Recently the Chicago Forge and Bolt Company make a test of the crushing strength of some samples of brick, with the following results:

Makers.	Ultimate Strength.
Anderson Press Brick Co., Chicago	114,000
" " " "	168,000
" " " "	192,000
Hydraulic Press Brick Co., St. Louis	390,000
" " " "	324,000
" " " "	342,000
" " " "	432,000
Ittner Bros., St. Louis	192,000
" "	168,000
Standard Press Brick Co., St. Louis	138,000
Columbus Br. and Ter. Cot. Co., Columbus, O.	156,000
Menomonie Press Brick Co., Menomonie, Wis.	114,000
Townshend & Co., Zanesville, Ohio	132,000
Feli, Roberts & Co., Trenton, N. J	216,000
Peerless Brick Co., Philadelphia, Pa	132,000
Burnham & Co., Milwaukee	126,000
Burns, Russell & Co., Baltimore	192,000
Chambers Machine, Chicago	114,000
Toledo Brick Co., Toledo	105,000
Purington & Kimball, Indiana	156,000
Hinchcleff & Owen, Chicago	132,000
Hinchcleff & Owen, Anoka, Minn	123,000
Union Press Brick Works, St. Louis	210,000
Tiffany Brick Co., Momence, Ill	258,000
Decatur Tile Co., Decatur, Ill	252,000
" " " "	228,000
" " " "	210,000
" " " "	318,000

Pumping Engines.—The following bids have been received by the Water Works Committee, of Hamilton, Ont., for pumping-engines with a capacity of 8,000,000 gallons daily:

McKechnie & Bertram, Dundas, Ont., piston speed 240 feet per minute, steam pressure in boiler 125 pounds, price, $49,000.

Osborne & Killey, Hamilton, Ont., piston speed 218 feet, steam pressure 100 to 110 pounds, price, $53,000.

H. R. Worthington, New York, piston speed 100 feet, steam pressure 92 to 100 pounds, price, $74,000.

George F. Blake, Boston, piston speed 250 feet, steam pressure 125 pounds, price, $68,450.

Holly Manufacturing Co., Lockport, N. Y., piston speed 200 feet, steam pressure 100 pounds, price, $49,000, for a pumping-engine of 100,000,000 duty.

Holly Manufacturing Co., Lockport, N. Y., piston speed 125 feet, steam pressure 80 pounds, price $39,000 for 105,000,000 duty.

Paving.—The following bids have been received for granite block paving on Broadway, Brooklyn, outside the railroad track: John McNamee, granite pavement, $2.45 per square yard; new curb, 75 cents per lineal foot; bridge stone, 60 cents per square foot; line of improvement $1.25 per lineal foot. D. H. Valentine, $2.39; 75 cents; 60 cents, $1.25. Charles Hart, $2.29; 43, 37, and 13 cents. Thomas McCann, $2.25; 50, 40 and 50 cents. James F. Gillen, $2.19; 47, 35 and 1 cent. Thomas Monahan, $2.07, 50 and 45 cents.

Contractors Intelligence,

Reported by T. H. Boorman.

Engineering and Building Materials.

WHOLESALE PRICES.

New York, August 5, 1886.

IRON.

STRUCTURAL IRON.			
Angles	2.00c	@	2.10c
" steel	2.35	@	2.45
Tees	2.35	@	2.45
Beams and channels, American	3.0	@	
Tank plates	2.10	@	2.20
Shell plates	2.4	@	2.5
Steel plates, Tank	2.70	@	2.75
WROUGHT-IRON PIPE, PITTSBURG.			
Butt welded, black Discount			45
" " galvanized "			35
Lap welded, black "			60
" galvanized "			42½
Boiler tubes "			52½
RAILS.			
Steel (large lots at mill)	$31.00	@	$35.00
Old rails	18.50	@	18.75
Old rails, steel	22.00	@	23.00
R. R. spikes			2.40c
R. R. splice-plates	1.80	@	2.00
R. R. track bolts, square nuts	3.00		
Barb-wire fencing, galvanized	4.38		
" painted			4.00
Corrugated iron			
Nails			
Iron, per keg	2.10		
Steel do.	2.20	@	2.25

METALS.

COPPER.			
Lake Superior	9.90	@	9.95
Other Brands	9.38	@	9.75
LEAD.			
Com. Domestic	4.76	@	4.80
Lead Pipe	.06¼c.		
Tin-Lined Lead Pipe	.15		
Sheet Lead	.07¼		
ZINC.			
Sheet	$5.80		

BRICK.

Cargoes (afloat)			
Choice Brands	7.50		
Haverstraw per M.	6.25	@	7.00
Fishkill	7.00		
Up-River,	6.00	@	6.50
Jerseys	5.50	@	6.00
Long Island			
Pale	4.50	@	4.75
FRONTS.			
Croton, red	11.00	@	15.00
" dark	11.00	@	15.00
" brown	10.00	@	14.00
Philadelphia pressed	27.00	@	28.00
Trenton "	25.00	@	26.00
Baltimore "	37.00	@	41.00
Buff "	33.00	@	35.00
Enameled English	85.00	@	130.00
" American	80.00	@	120.00
Fire brick	25.00	@	55.00
" American, No. 1	30.00	@	35.00
" " No. 2	25.00	@	30.00

ASPHALT.

ROCK.			
French	$20.00	@	25.00
German	15.00	@	20.00
According to quantity or brand, and whether taken from vessel or store.			
PAVEMENT.			
Barber's Asphalt	$2.50	@	$3.00

LIME.

Rocklock Cement Co.'s Ground	.80		
Rockland, common per bbl	1.30		
" finishing	1.20		
State, common	.85		
" finishing	1.15		
Kingston, ground	.90		
Add 25c. to above figures for yard rates.			

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95	@	1.00
" " No. 2 "	0.75	@	0.85
" " light drab "	0.80	@	0.95
Berlin " in rough "	0.75	@	1.00
Berea " " "			
Brown stone, Portland, Ct. "	1.00	@	1.35
" Belleville, N. J. "	0.75	@	1.35
Granite, rough	0.45	@	1.25
Common building stone per load	2.00	@	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@	3.00
Concrete and macadam stone, Tomkins Cove, per cub. yd			$1.65

SLATE.

Purple roofing per square	6.00	@	7.00
Green "	6.00	@	7.00
Red "	15.00		
Black Penna. (at New York) "	4.50	@	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@	20.00
" Choice "	65.00	@	70.00
Tally plank, 1¼ in. 10 in. dres'd. each.	.44	@	.50
Tally boards, dressed com. "	.28	@	.30
SPRUCE, Boards dressed "	.25	@	.28
Plank, 1¼ in "	.28	@	.30
" 2 in. "	.38	@	.40
" 2 in. dressed "	.43	@	.45
Timber per M.	13.00	@	16.00
HEMLOCK, Boards each.	.18	@	.20
Joist, 2¾ × 4 to 4 × 6 in	.16	@	.44
OAK per M.	55.00	@	65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00	@	40.00
YELLOW PINE, Girders "	25.00	@	30.00
Dressed flooring "	28.00	@	35.00
SHINGLES, Extra shaved pine, 16in. "			
" sawed 18 in. "	5.75	@	6.00
LATH, Cargo rate "	2.00	@	2.10

PAINT.

Lead, white, American dry per lb	.04¾	@	.06½
" " in oil pure "	.07	@	.07½
" English, B. B. in oil "	.06¾	@	.08¾
" Red, American "	.06½	@	.07
Litharge "	05½	@	.06
Venetian red, American "	.01	@	.01¼
Indian red "	.08	@	.10
Vermillion, American lead "	.10¾	@	.11½
Paris green "	.15	@	.18
Umber, Amer. raw and powdered per lb.	.01¾	@	.01¾
Drop black, Amer. "	.07	@	.13
" " Eng. "	.11	@	.13
Chrome green "	.10	@	.25
Oxide zinc, American "	.03½	@	.03½
" French "	.06½	@	.07¾

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be Wholesale in New York, subject to such special rates as large quantities may warrant:

CALVIN TOMKINS:			
"Old Newark Co's." Cement			$1.10
BAETJER & MAYERSTEIN:			
Hanover Portland	$2.60	@	$2.65
BELLONI & Co.:			
Hemmoor "Crown" brand			2.50
JAMES BRAND:			
Burham	2.25	@	2.50
Fewen	2.25	@	2.50
BROOKS, SHOOBRIDGE & Co.	2.45	@	2.60
HOWARD FLEMING:			
Gibbs' English Portland, 400 lbs.	2.50	@	2.75
K. B. & S. "	2.25	@	2.50
Stettiner, German	2.65	@	2.85
Lagerdorfer, "	2.45	@	2.75
Fieve, A 1, Belgian	2.35	@	2.50
Roman	2.75	@	3.00
Keene's Coarse	4.75	@	5.50
" Fine	7.75	@	8.50
" Superfine	8.50	@	10.00
FISHER, ERSKINE W.:			
Stettin (German) Portland Cement	2.40	@	2.75
GABRIEL & SCHALL:			
Vorwohler "Lion"	2.65	@	3.10
HUDSON RIVER CEMENT Co. Rosendale			6
JOHNSON & WILSON:			
Saylor's American Portland	2.15	@	2.45
LESLEY & TRINKLE, Philadelphia, Pa.:			
"Giant" Portland	2.20	@	2.40
Improved "Union"	1.25	@	1.50
Union	1.10	@	1.20
MARCIAL & Co.:			
J. B. White & Bros. Coarse Keene's	4.25	@	4.50
" Superfine	7.25	@	7.50
" Portland	2.65	@	3.00
NEW YORK CEMENT Co.:			
Rosendale			1.10
N. Y. & ROSENDALE CEMENT Co.:			
Rosendale, "Bridge" brand			1.10
SINCLAIR & BAGSON:			
Alsen's Portland Cement Works	2.35	@	2.85
K. B. & S.	2.25	@	2.50
STANDARD CEMENT Co			
E. THIELE:			
Dyckerhoff	2.90	@	3.25
UNITED STATES CEMENT Co.:			
English Portland	2.25	@	2.40
German "	2.00	@	2.15
Standard	1.50	@	1.65
Windsor and Improved Rosendale	1.00	@	1.10
UNION AKRON CEMENT Co.:			
Akron "Star" brand	1.00	@	1.10

MARKET SUMMARY.

The building material market had a blow this week in the shape of the failure of one of the oldest houses in the trade with liabilities causing losses to many of the manufacturers and importers. The prices of all material have been remarkably steady and no change is to be noted in the price of brick; the strike at Verplanck has fortunately terminated and arrivals and sales have been steady at quotations given above. The cement market is about as last week; it is reported that 10 000 barrels of Portland were sold this week for use on the aqueduct and the sale of 1,200 barrels of "Star" German was made to a Philadelphia purchasar for direct shipment from Stettin. The Lumber Market is not particularly active and buyers not very eager; it is unfortunate that there should be no Lumber Exchange in this city; it was anticipated that some steps would be taken to make this interest a more important feature in the "Building Material Exchange," especially this year when a President representing that trade was elected. Lath are selling in fairly large quantities at $2 to $2.10 per M, and sales of Maine cargoes, are reported at the former figure. Spruce timber is in limited request with small sizes selling at about $13.00 per M and desirable schedules at $15.50 per M. Yellow pine random cargoes $18 to 19.50 per M, special cargoes $19.50 to $21, green flooring boards $17 to $18, dry $21 to $22. Paints and oils about as last week. Lead not so firm, a sale of 250 tons of common Western reported at $4.80. Tin plates are very dull and sales small at previous rates. Lime does not fluctuate in price, a fair demand is found for Rockland and manufacturers are careful not to crowd the market. State Lime is very quiet. Cattle Hair is quoted firmer at 21 cents with better enquiry than for some months past, the season has been retarded and it is only now that out of town orders have been received to any extent. The Hardware Market is far from brisk and immediate orders not plentiful, Country orders are commencing to be more frequent, prices are steady but hardly firm yet. Nails are in moderate demand only and are sold at $2.10 to $2.20 per keg for 10d. to 60d. according to size of invoice. Coal Tar and its products are firmly held at prices agreed upon last January. Asphalt and bituminous products in fair demand.

Stone for concrete purposes has been in active demand. Calvin Tomkins has the order for that required for the new Army Building on Whitehall street, and reports sale of 20,000 yards for use up the river.

BUILDING ITEMS.

During the month of July plans for the erection of 338 new buildings, to cost $3,763,060, were filed in the Building Bureau.

Mr. Joseph Stern has filed plans at the Bureau for a two story beef refrigerating house, which at a cost of $25,000, will be built at Nos. 617,619, 621, and 623 West Twenty-ninth street. The building will be 110 feet front and rear and 100 feet deep.

Richard Irvin, Jr., filed plans for a thirty-thousand dollar stone and brick dwelling at No. 12 West Thirty-Sixth street.

Mr. C. P. Huntington, of the Morgan Steamship Line, has filed plans for shedding the bulkhead on West street at pier (new) 57. They have been referred to the Engineer for his approval.

The Pennsylvania Railroad Company, if Engineer Greene approves their plans, will repair at their own expense pier (old) 39 North River.

Estimates are being received by the Revd. Dr. S. B. Smith for the new Catholic church to be erected at Paterson, N. J., from plans of Messrs. Wm. Shickel & Co., of New York.

The contract for the building to be erected for the Little Sisters of the Poor on Seventieth street near Third avenue has been awarded to Cornelius Callahan. Mr. L. J. O'Connor is the architect.

The Park Commissioners on Wednesday opened bids for the work of erecting the new wing to the Museum of Art Building. The lowest bids were as follows:—Mason work, John Cox & Co., $176,987; iron work, Wallace Iron Company, $83,009; carpenter work McQuade & Sleven, £24,752; and plumbing, P. J. Cochran, $1 100, making a grand total of $286,839. As the appropriation for the work is $325,000, the Commissioners will now be enabled to go on with the work. At the last opening of bids, the bids exceeded the appropriation, and they were rejected.

A new pier is to be built around the New York tower of the Brooklyn Bridge for use by the Clyde line.

Havemeyer & Co., are going to build a new office, 27x69 feet, on Commercial street, Greenpoint.

Mr George W. Debevoise the new Superintendent of School buildings reports that the next school house to be put under contract will be the one to be erected in Fiftieth street between Ninth and Tenth avenues, the cost of which is estimated at $120,000.

Mr. H. C. Blanchard has plans on the boards for a new building to be erected by the Anchor Brewing Co., at Dobbs Ferry, N. Y., Messrs. Schwarzmann & Buchman are preparing plans for additions to be made to the Manhattan Hospital on Tenth avenue and 131st street.

Mr. Charles D. Marvin reports that plans for the Adams Chewing Gum factory on Sands street, Brooklyn, have been changed and the building is to be six stories high, 55x100, costing about $65,000.

The Commissioners of Charities and Corrections, have invited proposals for the erection of a Dead House for Bellevue Hospital, estimates to be received up to 9:30 A.M., August 10th.

Alterations are to be made to the Thirteenth street Presbyterian church between Sixth and Seventh avenues, embracing a new stone front and two towers. Mr J. R. Thomas, architect.

A new church, which is to be named the People's Congregational church, under Rev. Arthur Chester as pastor, is to be built on the corner of Bushwick avenue and Cornelia street Brooklyn.

A new Catholic church is to be erected at Great Neck, L. I., in a few weeks.

The Revd. Father Callahan proposes to have a brick church built at Elizabeth, N. J., from plans of Mr. B. O'Rourke of New York. A plot of land, 75x200, has been purchased on 113th street between Second and Third avenues by the Revd. B. Frey on which will be erected the Catholic church of Our Lady of Angels with convent and school buildings.

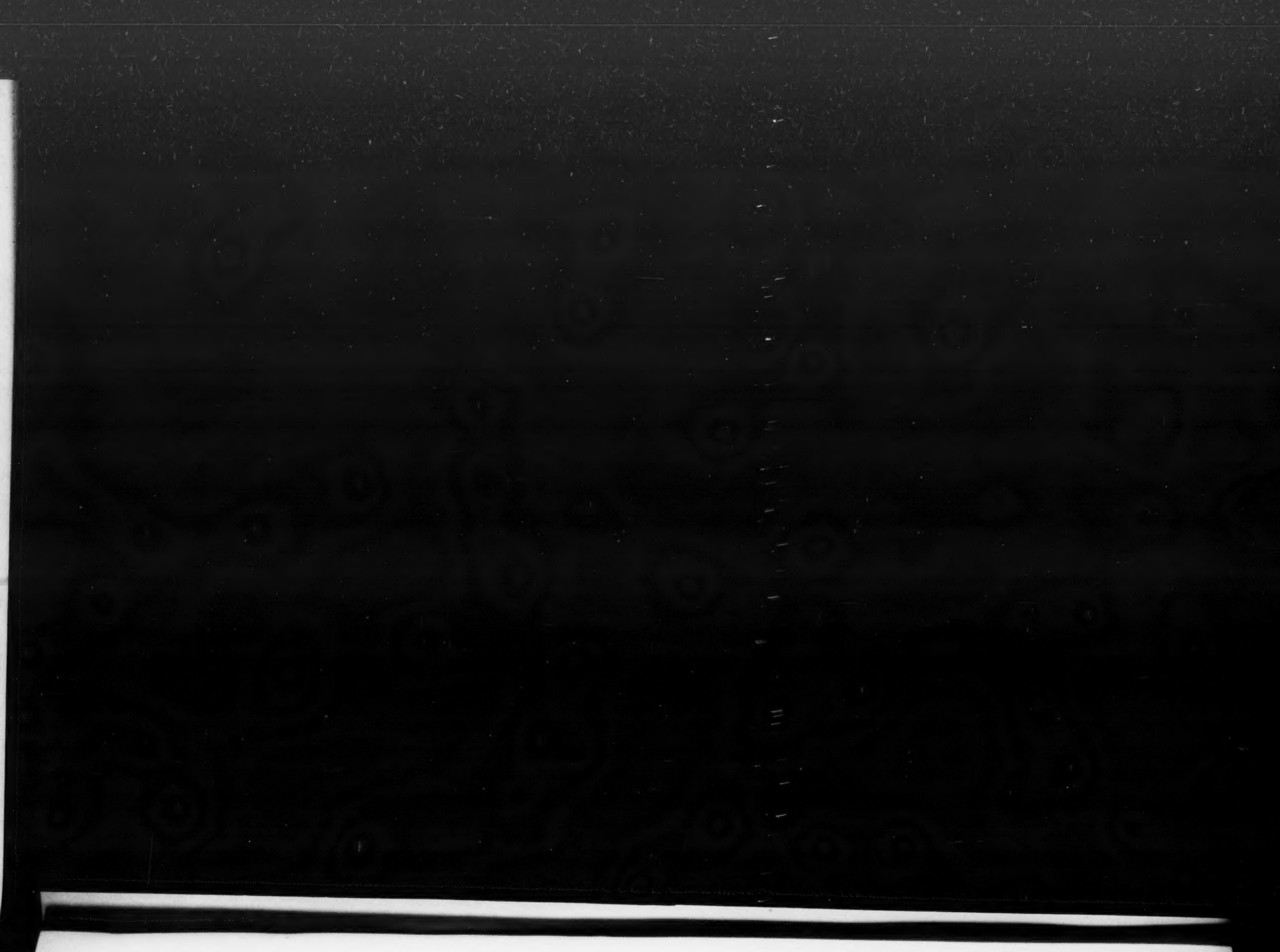
Mr. Herman Koehler will expend $55,000 on improvements to his malt house on First avenue between 29th and 30th streets.

Messrs. St. Ottenburg & Bro., 340 E. 23rd. street are to have an extension 48, x 60, built at a cost of $40,000 from plans of Messrs A. Zucker & Co. Mr. Jas A. Bailey is to have a handsome stone residence, 56 x 72, three stories and basement erected on the N. E. corner of St. Nicholas Place and 115th street at a cost of about $80,000, from plans of Mr. S. B. Reeds. Messrs Hubert Pirson & Co., have prepared the plans for a two-story and basement brick extension 21, x 33.6, to be added to No. 8 W. 52nd street to cost $40.000. Mr. McCoskey Butt, owner.

Plans have been filed for the parochial rooms of St. George's church to be erected at Nos. 203 to 207 E. Sixteenth street at a cost of $160,000. Mr. Leopold Eidlitz is the architect and Messrs. Marc Eidlitz & Son, contractors.

Mr. Z. J. Halpin will have a three story and attic residence, 37 x 40 erected on the north side of 142nd street, east of the Grand Boulevard, from plans of Mr. John Duncan.

WASHINGTON, D. C.—The report of the operations of the Build-Inspector's office for July shows that permits were granted for the erection of 235 new buildings and 197 repairs to buildings. The number of new buildings for the month was fifty-two more than for the corresponding month the previous year.

Messrs. Berg & Clark report plans finished for a residence to be built at Sharon, Conn., for Mr. C. Adolphe Low to cost $10,000. The United Bank Building at Danbury, Conn., of which they are the architects, is now under way. Mr. S. B. Reed of Hartford is the contractor.

Col. Henry C. Hodges, Deputy Quartermaster-General U. S. A. on Monday opened the bids for mason and carpenter work for the new Army Building to be built on Whitehall street. Bidders for mason work were as follows: List & Lennon, $110,470, vaults $3,650; Moran & Armstrong, $101,393, vaults, $6,950; Isaac A. Hopper, $116,490, vaults, $2,754; Robt L. Darragh & Co., $110,795, vaults, $2,036; John Cox & Co., $131,630, vaults, $2,000; James B Smith & Co., $125,860, Vaults, $2,750; Carpenter work, $24,722.40; making a total of $153,322.40 for the complete work. For carpenter work, William Russell, $17 986; Jas. L. Lowery, $16,900: Contract not awarded at time of writing. The bid of Post & McCord has been previously accepted for the iron work.